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WATER WORKS & SEWERAGE

March, 1936 — Editor — Volume 83. No. 3

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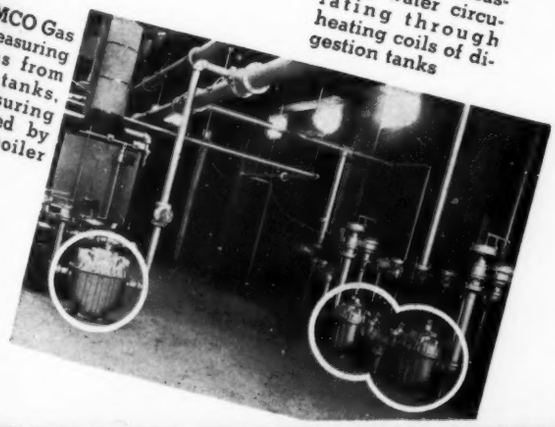
Pittsburgh Hot Water Meter measuring water circulating through heating coils of digestion tanks



(Right) EMCO Gas Meters measuring sewage gas from digestion tanks. (Left) measuring gas consumed by hot water boiler

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WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"A Filtration Plant of Novel Design"—by W. Martin Johnson of Wiley and Wilson, Engrs., Lynchburg, Va., describes and pictures a gravity filtration plant of a most unusual design which is under construction at historic and cultured Lexington, Va. Located on a hill behind the city, it overlooks the barracks of the Virginia Military Institute and the tomb of "Marse" Robert E. Lee on the campus of Washington and Lee University. To tell more would rob a prized article of its feature of surprise. Novel in design, and startling in appearance, this unusual plant was developed as the solution of a problem in operating economics and technical adaptability.

"Emptying Water Mains With Compressed Air"—Roger W. Esty and Nelson Boardman, Sup't and Ass't Sup't of the Danvers (Mass.) Water Department, will describe a very practical method of emptying water mains which was developed in Danvers and has proved effective in precluding or minimizing ditch pumping when cutting a line for repairs. This article is one of several to be contributed by water works operators during the year in a "Practical Operating Kink" series.

"Another Operating Kink" type of article is to be contributed by Eugene Cranch, Manager-Superintendent, New Rochelle (N. Y.) Water Company. He tells of an improved method and describes the equipment used in making "cut-ins" for distribution system laterals and the larger sizes of service lines. Simplicity, and economy in time and labor, are the outstanding merits of the method which Mr. Cranch describes.

"Practical Hydraulics"—P. S. Wilson, Water Works Consultant of Glen Ridge, N. J., who was formerly an operating engineer with Community Water Service Company, will continue with his series of valuable articles written more especially for the benefit of practical water works operators. Three of the series by Mr. Wilson have appeared in earlier issues. When completed the whole series will be reprinted under one cover as a "Water Works and Sewerage" monograph.

"Sewerage Kinks"—by A. M. Rawn, Ass't Chief Engr., Los Angeles County Sanitation Districts and President of the California Sewage Works Association, constitutes a follow-up article to his previous contribution "Sewer Cleaning with Rubber Beach Balls" which appeared in WATER WORKS and SEWERAGE for October, 1935. In the forthcoming article, Mr. Rawn describes several useful "Kinks" employed in sewer maintenance and plant operation under his supervision.

"Garbage Disposal via Sewage Treatment" is a subject of considerable current interest. Cecil K. Calvert, Engineer-Manager of Waste Disposal Plants, Indianapolis, Ind., will disclose the results of large scale experiments, wherein ground or shredded garbage has been put through the Indianapolis Activated Sludge plant in varying quantities.

"Methods of Treating Milk and Milk Products Wastes"—by L. F. Warrick, State Sanitary Engineer of Wisconsin, describes practical methods utilized in treating milk wastes in Wisconsin, results secured and costs.

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Above: Nichols Herreshoff Sewage Sludge Incinerator installation at the West Side Disposal Plant at Dearborn, Michigan. *Left:* Open Hearth of Incinerator in action.

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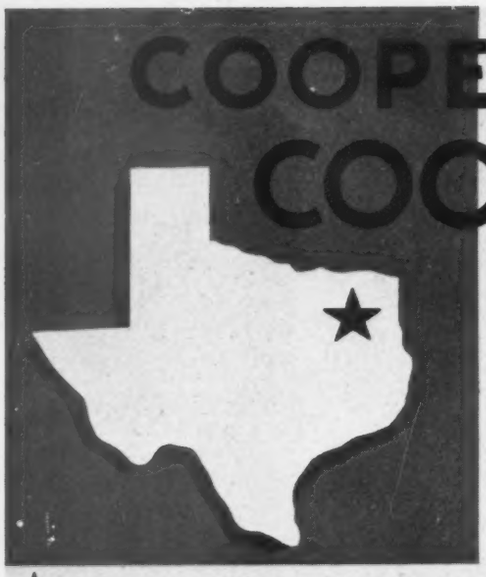

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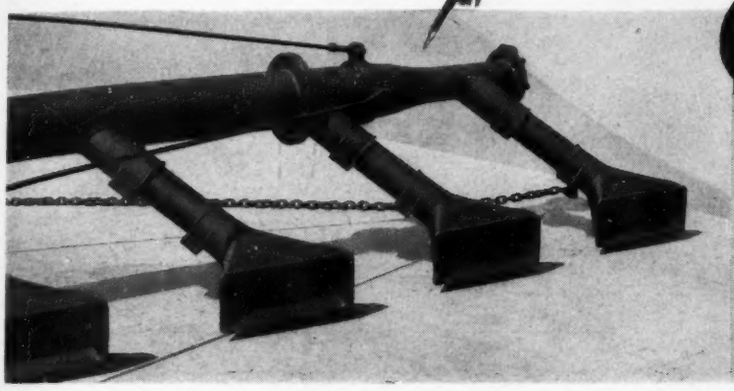

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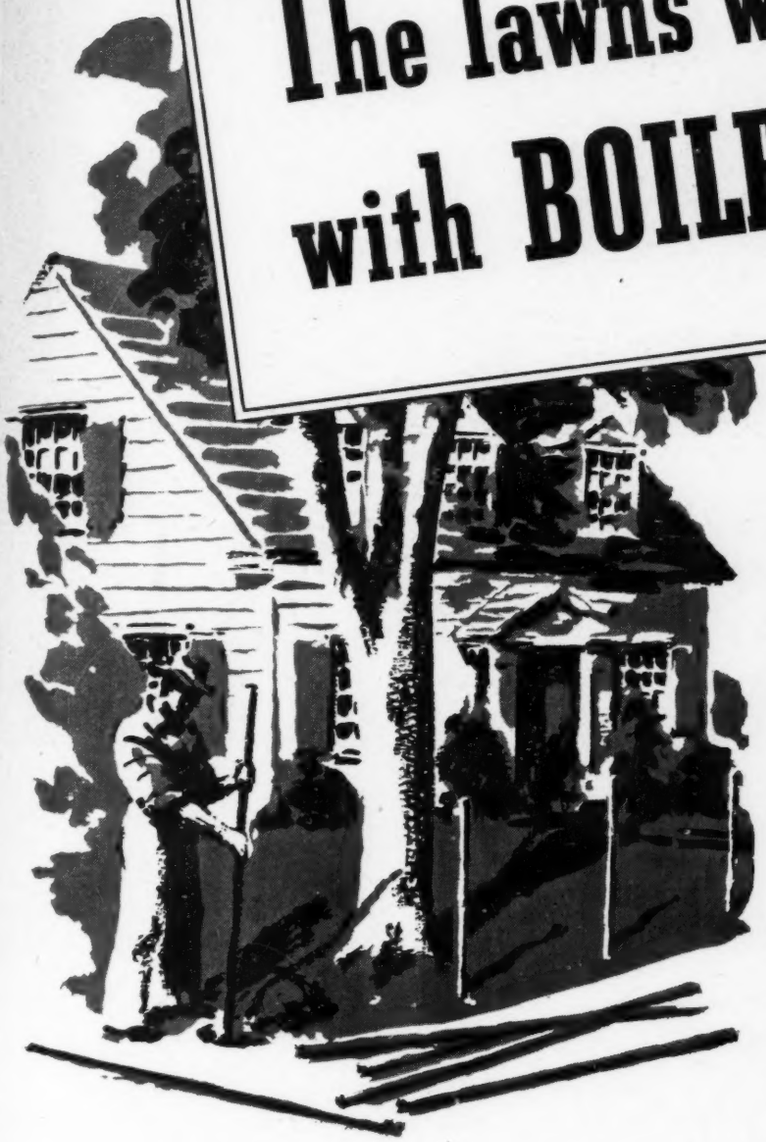

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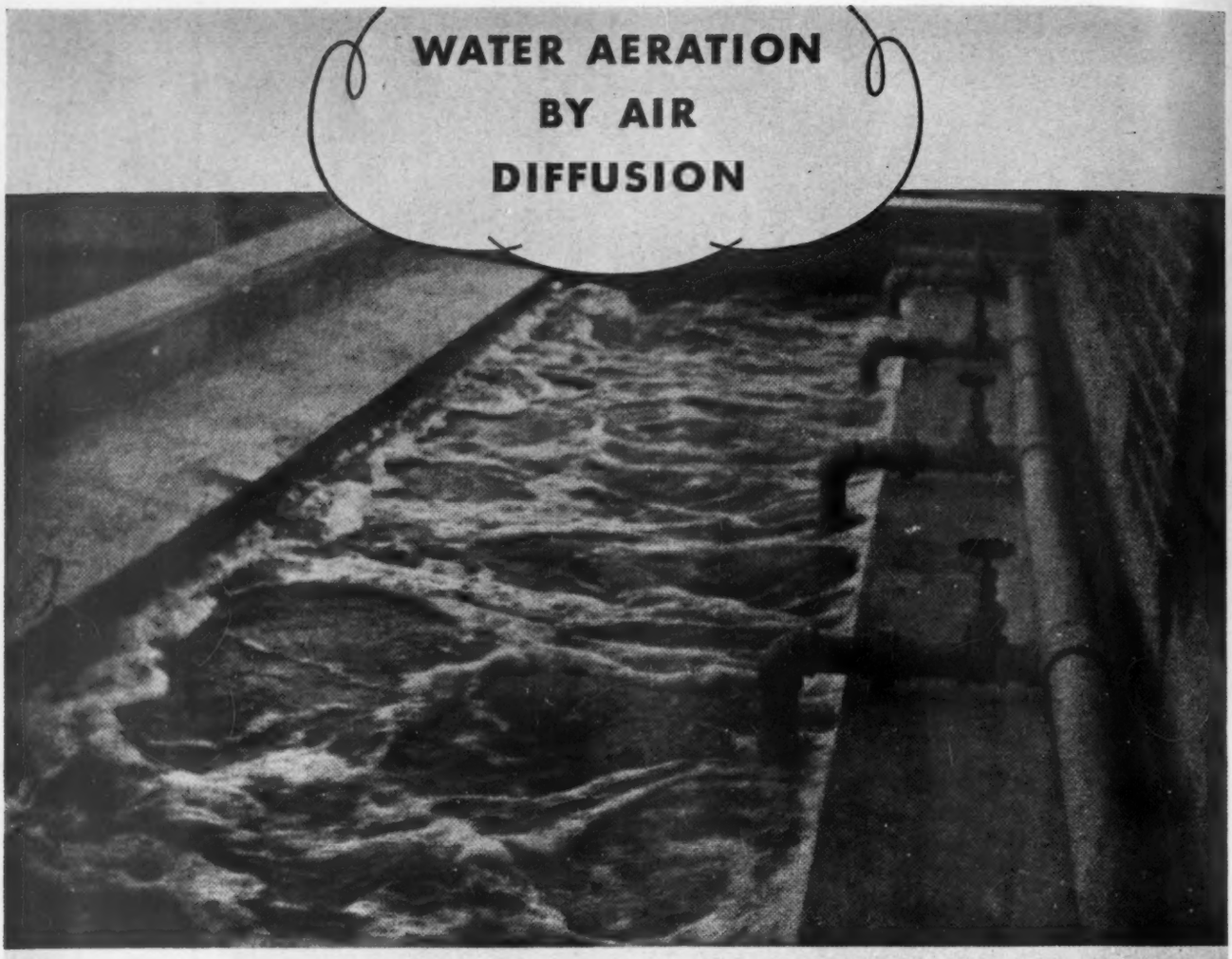

Aeration tank at Huntingburg, Ind. water treatment plant. Charles Brossman, Consulting Eng., Indianapolis. An Aloxite Brand Installation.

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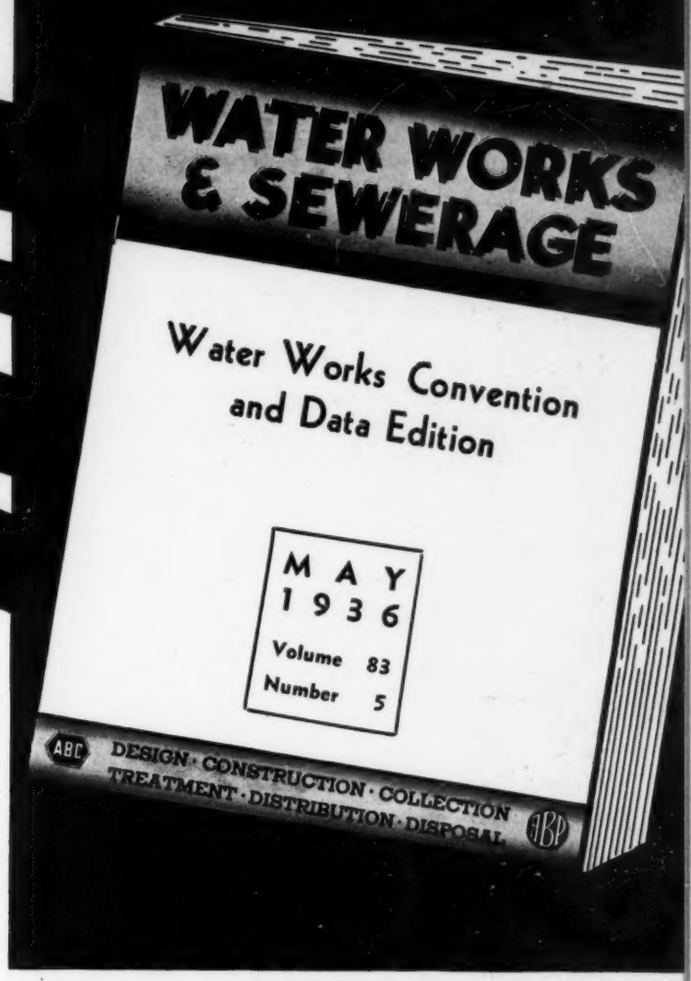

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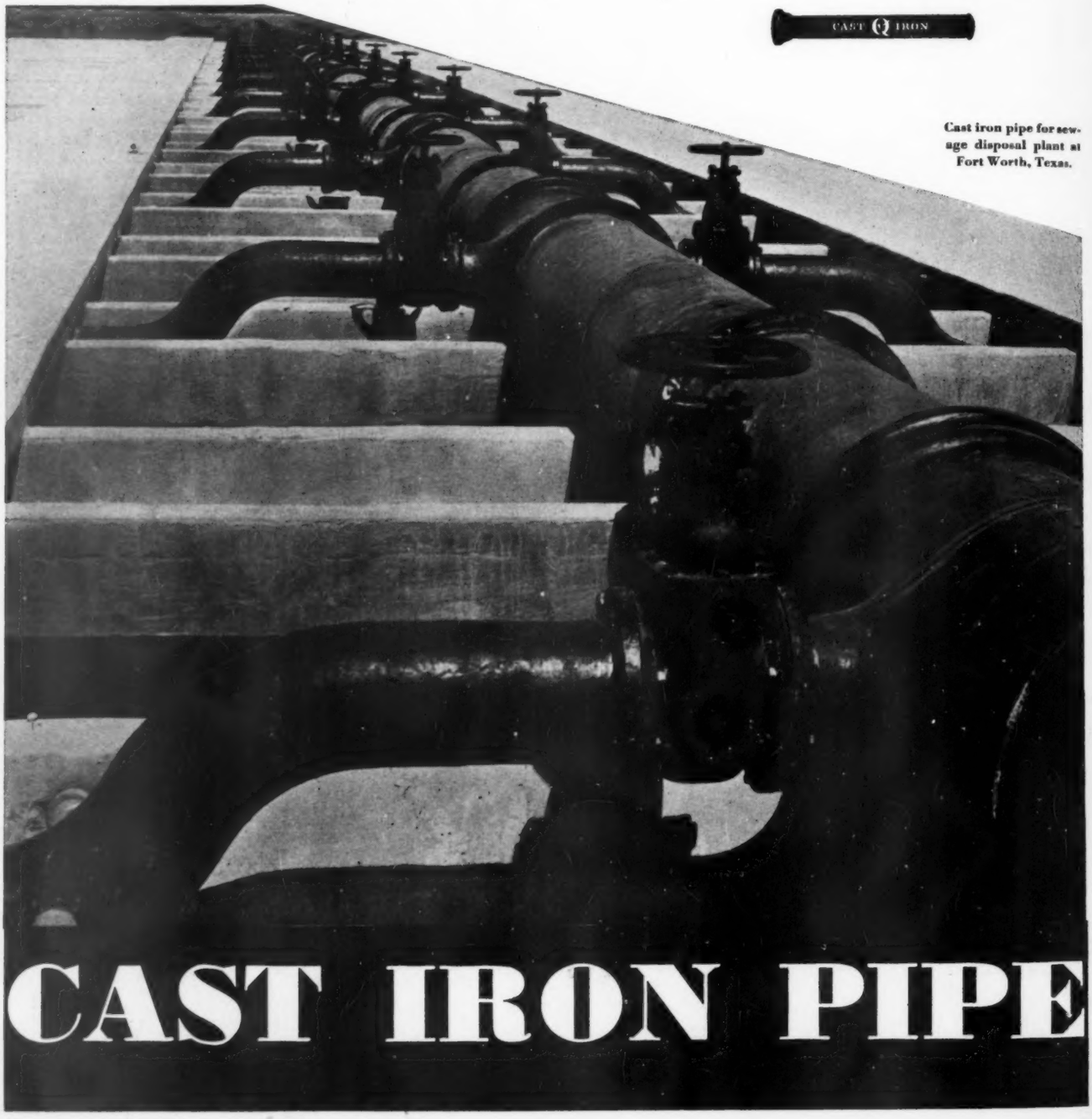


Cast iron pipe for sewage disposal plant at Fort Worth, Texas.

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 83 MARCH, 1936 No. 3

THE ECONOMICS OF VARIOUS METHODS OF SLUDGE DISPOSAL

By A. J. FISCHER*
Development Engineer,
The Dorr Company, Inc.,
New York City.

A. J. Fischer

DURING the last few years a number of advances have been made in the treatment and disposal of sewage sludge by improved methods of digestion, dewatering on vacuum filters and final disposal by incineration.

Elimination of the digestion step and direct filtration and incineration of raw sludge has been advanced as an alternate method of complete disposal while centrifuges and sludge dryers are still in an experimental stage. Whether or not these more recent innovations will be made to successfully compete with the older methods of sludge treatment can only be determined after a number of plants now under design or being contemplated reach the operating stage. Only then can reliable cost data be collected and possible improvements be made.

Based on information obtained from semi-plant and regular plant scale tests there appears to be no question that all types of sludges now obtainable in sewage treatment may be dewatered and incinerated in either a raw or digested state. There is a definite question, however, whether certain procedures are economically justified. While economics are not always a deciding factor because of certain local conditions, they are important and warrant careful consideration.

The purpose of this paper is to present an economic analysis of the filtration and incineration of raw primary and mixed sludges as against digestion of these sludges followed by open or covered sand bed drying; or, by vacuum filtration with or without incineration, based on present available plant and large-scale experimental data.

Scope of Analysis

In order to make a comprehensive survey of the field, installation and operating costs have been computed for 2, 5, 10, 25, 50 and 100 m.g.d. plants producing the following types of sludges: primary; primary plus trickling filter; primary plus chemically precipitated; and primary plus activated sludge. In addition, costs were figured for a combination of digested primary plus undigested activated sludge.

In the three smaller plants, it is assumed that the filters and incinerators are operated an average of 8 hours per day. Continuous operation is assumed for the three larger plants.

Peak Sludge Loads

An important consideration in the design and operation of sludge handling plants is that regarding peak sludge loads. Very little thought had been given to this point in the past where digestion was employed because the digesters, which were always liberally designed, acted as "balancing tanks" and smoothed out these peaks. Now, with tendencies toward short time digestion or elimination of digestion entirely, this factor has a greater bearing on plant design. It is believed that this fact was first appreciated by the Chicago Sanitary District in connection with their recent work on raw primary and activated sludge incineration.

Figure 1, shows a typical relationship between peak raw sewage solids loads and duration of time when these peaks persist. It represents a composite study of peak loads obtained at Chicago, Cleveland, Columbus, Syracuse, Rochester and other large American cities. This curve was prepared by Mr. R. A. Allton[1], Sanitary Engineer of Columbus, Ohio, in connection with the study of the design of a sludge handling plant for the new Columbus treatment plant. This curve is characteristic of large cities having a number of sewers laid on flat grades. In such cases the abnormal sludge loads obtained during short periods are occasioned by flushing out of the sewers during storm flows. These peaks are more marked where the sewage is from combined systems and where the sewer system covers a large area. In smaller plants, say of less than 10 m.g.d.

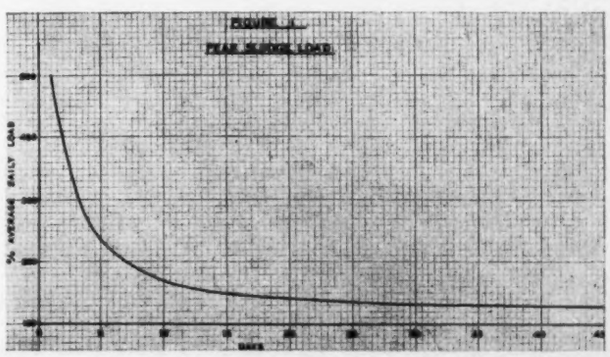


Fig. 1.—Typical Relationship Between Peak Loadings of Crude Sewage Solids and Duration of Such Loadings.

*This article, prepared for WATER WORKS AND SEWERAGE, was presented before the New York State Sewage Works Association at its 8th Annual Meeting, New York City, January 15, 1936.

capacity, these peaks may be of lesser intensity and possibly of a shorter duration.

The curve of Figue 1, is not intended as a yard stick in the design of all plants, nevertheless, where specific local data are lacking it shows what might be expected. Therefore, the probability of obtaining these peaks must be recognized by furnishing sludge handling facilities to take care of these peaks or by supplying sufficient sludge storage capacity to reduce them to a figure consistent with the lesser sludge handling facilities that may be provided.

Experience indicates that if raw primary sludge is stored longer than about two days it becomes septic, giving rise to odor nuisances and requiring a greater amount of coagulent preparatory to dewatering on vacuum filters. Therefore, assuming that peak loads similar to those shown in Figure 1, are obtained, filter and incinerator capacities should be furnished to handle 375 per cent of the daily average sludge load where raw sludge is filtered and incinerated direct. Similarly, where short-time digestion periods of 20 days are contemplated, the filters and incinerators should be designed for 140 per cent peaks. Where 20 days primary and 30 day secondary digestion is used, these units should be capable of handling 125 per cent peaks. In the case of activated sludge, 125 per cent peak load designs are adequate as the aeration tanks may be used to store this type of sludge.

Basis of Design

In this comparison, it is assumed that when raw sludge solids are incinerated direct, they are stored for two days in mechanically equipped sludge thickeners prior to dewatering and incineration. In order to show the effect of widely divergent conditions, maximum peak loads of 125 per cent and 375 per cent of the daily average have been assumed.

Where digestion is used, it is assumed that a 20 day primary and a 30 day secondary digestion period is provided ahead of vacuum filtration, while a 20 day primary and a 60 day secondary digestion period is provided in the case of sand bed drying. In all cases of digestion, 125 per cent peak loads are assumed for the dewatering and incinerating units.

Detailed design data are given in Table 1. In each case, where secondary treatment is used, it is assumed that it is preceded by primary sedimentation wherein 60 per cent of the suspended solids are removed. Chemical treatment is taken as treatment of pre-settled sewage by means of 30 ppm. of ferric chloride.

Suspended solids in the raw sewage are taken as 0.17 lb. per capita or 204 p.p.m., of which 70 per cent is volatile matter. This is a fair average for a domestic sewage from a separate system where there are no predominating trade wastes present. Total suspended solids removals are as shown. In the case of trickling filter treatment it is assumed that 8 per cent of the raw sludge solids, or 135 lb./m.g. of sewage disappear in the trickling filter and do not have to be handled in the digestion or dewatering operation.

In computing the size of sludge thickeners (concentrators) or storage tanks, three feet are added to the sludge depth for supernatant liquor to assure an adequate clarification zone at all times. These units are operated on a continuous basis, the sludge depth being varied to give the required detention period. In warm climates where septic action may occur in less than two days, chlorine may be applied to delay this septic action. These tanks have a floor slope of one inch per foot.

Digestion tank sizes are calculated on the basis of the amount of total dry solids, volatile matter, sludge mois-

TABLE 1—DESIGN DATA

Sewage flow = 100 gals./capita.
Raw sewage solids taken at 0.17 lb./capita, 70% volatile matter.

	Primary Treatment	Trickling Filter Treatment	Chemical Treatment	Activated Sludge Treatment	Activated Sludge Alone
Overall suspended solids removal	60%	85%	80%	95%	
Raw sludge—dry solids/m.g.d.	1,020 lb.	1,310	1,525	1,615	
Raw sludge—per cent moisture	94	95	95	96	98.8
Raw sludge—thickener final per cent moisture.	90	92	92	93	96
Raw sludge — thickener average per cent moist.	92	93.5	93.5	94.7	97.4
Thickener sludge detention	2 days	2 days	2 days	2 days	
Digested sludge—dry solids/m.g.d.	555 lb.	710 lb.	905 lb.	1,035 lb.	
Digested sludge—per cent moisture	91.2	93.1	93.1	94.5	
Digester—per cent solids reduction	45.5	45.5	41	36	
Digester—per cent volatile reduction	65	65	58.5	51.5	
Digester—gas—cu. ft. per m.g.	7,900	10,200	10,650	9,850	
Digestion period:					
(a) Primary	20 days	20 days	20 days	20 days	
(b) Secondary:					
Filtration	30 days	30 days	30 days	30 days	
Sand beds	60 days	60 days	60 days	60 days	
Total digester capacity:					
Cu. ft./capita (30 day sec.)	0.98	1.53	2.02	2.28	
(60 day sec.)	1.23	1.87	2.15	2.78	
Cu ft./lb. volatile matter added/day:					
30 days sec	13.7	16.7	21.2	20.1	
60 day sec	17.2	20.4	22.6	24.6	
Drying bed loadings—lb. Dry solids/sq. ft./year:					
Open beds	35	30	30	25	
Covered beds	70	60	60	50	
Incinerator-average tons water.					
Evaporated/24 hrs./m.g. sewage:					
Raw sludge	1.30	2.08	2.48	2.97	
Digested sludge	0.70	1.02	1.18	1.93	

TABLE 2—SLUDGE FILTRATION

Type of Sludge	Conditioner, per cent of Dry Sludge Solids		Filter Capacity Lbs./Sq. Ft./Hr.	Cake Moisture, per cent
Raw Sludge:	CaO	$FeCl_3$		
Primary	10	3	5	68
Primary plus trickling filter.	12	3	4	72
Primary plus chemical ($FeCl_3$)	12	3	4	72
Primary plus activated	..	6	4	78
Chemical ($FeCl_3$)	10	5	2	80
Chemical ($CaO + FeCl_3$)	8	3	6	66
Activated	0	6	2.5	80
Digested Sludges:				
Primary	10	2	6	68
or	0	6	6	72
Primary + trickling filter	12	2	6	70
or	0	7	6	74
Primary + Chemical ($FeCl_3$)	12	2	6	68
or	0	7	6	72
Primary + activated	0	8	2.5	78
Chemical ($FeCl_3$)	12	2	4	70
or	..	7	4	74
Checila ($CaO + FeCl_3$)	10	2	6	68
or	0	6	6	72
Activated	0	10	2.5	80
Mixed Sludges:				
Digested primary + undigested and activated	0	6	4.5	75

ture, volatile matter reduction in each digestion stage, and the reduction in sludge moistures in the secondary tank. Where continuous agitation is provided in the primary tank the required volume is equal to the desired digestion period in days multiplied by the volume of wet sludge added per day. The volume of the secondary tank depends on the type of sludge being treated. For a thirty days' storage period the sludge capacity is equal to the pounds of dry solids per day multiplied by the factor 3.25 in the case of primary sludge. For trickling filter and chemical sludge, this factor is 4.05 and for activated sludge 4.80. To the secondary tank sludge depths is added three feet for supernatant liquor clarification. The secondary tanks have floor slopes of three inches per foot.

Gas holders are provided on the secondary tanks to give a gas storage of 40 per cent of the average daily production. This allows for utilization of 90 per cent of all the gas produced.

Vacuum filters are designed on the basis of capacities given in Table 2. This table shows that filter rates, conditioner requirements, and cake moistures vary widely depending on the nature of the sludge. It further shows that the mere reference to a sludge as being "raw" or "digested" is misleading unless the specific source of the sludge is also designated. It is interesting to note that on all raw sludges other than activated, combinations of lime and ferric chloride are required for conditioning, while on all digested sludges other than activated, ferric chloride alone or combinations of lime and ferric chloride may be used. In all cases where activated sludge is included, ferric chloride alone is used, lime having little or no value when used in combination with the ferric salt. Chlorinated-copperas or ferric sulfate may be used as a substitute for ferric chloride. It is the writer's experience that about 25 per cent more chlorinated copperas or 75 per cent more ferric sulfate must be used than ferric chloride on an iron content basis.

Incinerators are designed on the basis of water evaporation, using the sludge moistures given in Table 2. It is noted that the weight of dry solids in the filter sludge cake is increased over that obtained from the thickeners or digesters because of the conditioner added. This may prove to be a considerable item and should be taken into consideration. Assuming that the lime is entirely converted to calcium carbonate, and the ferric chloride to ferric hydroxide the increase in dry weight in the filter cake is 1.78 per cent for each per cent lime, and 0.66 per cent for each per cent ferric chloride added.

Sand drying bed areas are based on the pounds of dry solids that can be dried per sq. ft. in one year. These figures are based on actual operating results and within limits are independent of the moisture of the sludge applied. The moisture of the air dried digested sludges is taken at 60 per cent for primary, trickling filter, and chemical treatment sludge and 65 per cent for activated sluges.

Installation Costs

Installed costs of sludge thickeners, digesters, vacuum filters and incinerators are given in Figures 2 to 5 inclusive. Open sand bed costs are taken at 50 cents per square foot and covered beds at $1.80 per square foot. To costs of all structures are added 5 per cent for

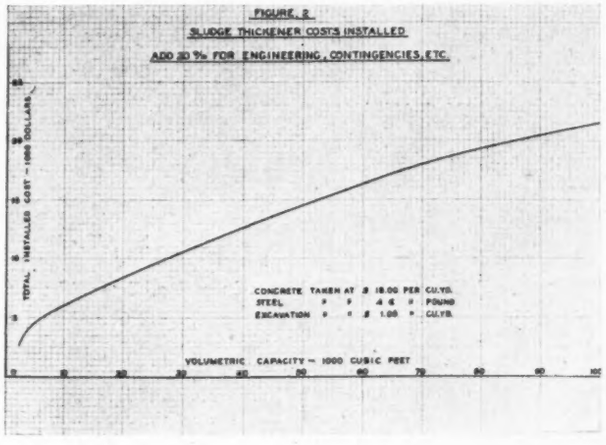


FIGURE 2
SLUDGE THICKENER COSTS INSTALLED
ADD 20 % FOR ENGINEERING, CONTINGENCIES, ETC.
TOTAL INSTALLED COST - 1000 DOLLARS
CONCRETE TAKEN AT $ 18.00 PER CU.YD.
STEEL " " .4 ¢ " POUND
EXCAVATION " " $ 1.00 " CU.YD.
VOLUMETRIC CAPACITY - 1000 CUBIC FEET

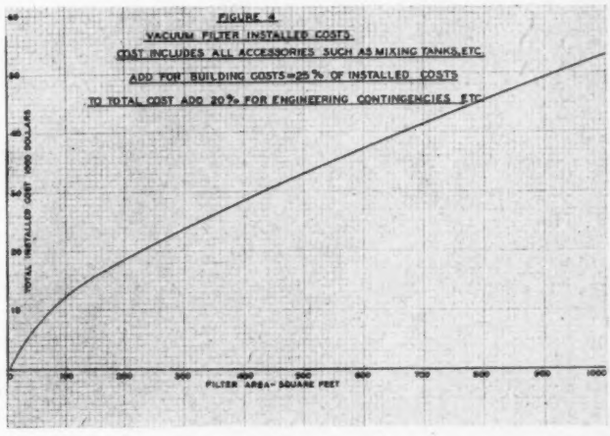


FIGURE 4
VACUUM FILTER INSTALLED COSTS
COST INCLUDES ALL ACCESSORIES SUCH AS MIXING TANKS, ETC.
ADD FOR BUILDING COSTS = 25 % OF INSTALLED COSTS
TO TOTAL COST ADD 20 % FOR ENGINEERING CONTINGENCIES ETC.
TOTAL INSTALLED COST 1000 DOLLARS
FILTER AREA - SQUARE FEET

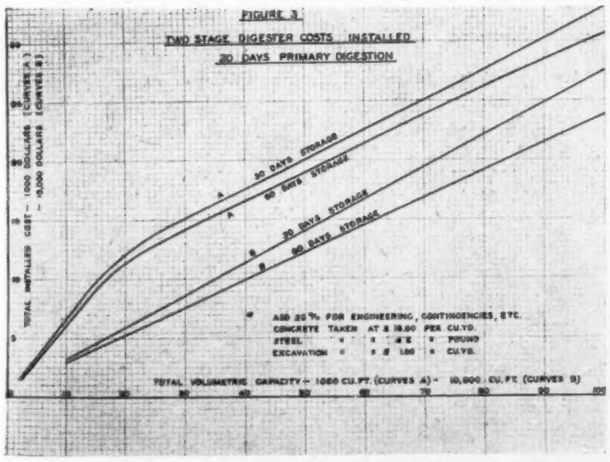


FIGURE 3
TWO STAGE DIGESTER COSTS INSTALLED
20 DAYS PRIMARY DIGESTION
TOTAL INSTALLED COST - 1000 DOLLARS (CURVES A)
- 10,000 DOLLARS (CURVES B)
A 30 DAYS STORAGE
A 60 DAYS STORAGE
B 30 DAYS STORAGE
B 60 DAYS STORAGE
ADD 20 % FOR ENGINEERING, CONTINGENCIES, ETC.
CONCRETE TAKEN AT $ 18.00 PER CU.YD.
STEEL " " .4 ¢ " POUND
EXCAVATION " " $ 1.00 " CU.YD.
TOTAL VOLUMETRIC CAPACITY - 1000 CU.FT. (CURVES A) - 10,000 CU.FT. (CURVES B)

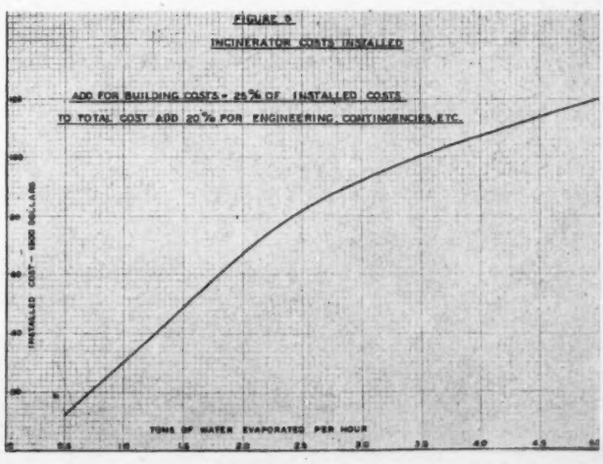


FIGURE 5
INCINERATOR COSTS INSTALLED
ADD FOR BUILDING COSTS = 25 % OF INSTALLED COSTS
TO TOTAL COST ADD 20 % FOR ENGINEERING, CONTINGENCIES, ETC.
INSTALLED COST - 1000 DOLLARS
TONS OF WATER EVAPORATED PER HOUR

Figs. 2-5.—Installation Costs of Thickeners, Digesters, Filters, Incinerators.

engineering and 15 per cent for contingencies such as inlet and outlet conduits and piping for thickeners; piping and control chambers for digesters; chemical storage, piping, etc., for vacuum filters; sludge handling equipment for sand drying beds; and ventilating equipment, etc., for incinerator. In no case is the cost of land included.

In all cases, the costs of the various structures includes concrete at $18.00 per cu. yd., reinforcing steel at 4 ct. per pound, and excavation at $1.00 per cu. yd., as well as the costs of all equipment, freight and haulage, erection, wiring, foundations, etc.

There appears to be some discrepancy in the lower range of the incinerator cost curve in that the cost increases a little more rapidly than the rated capacity figure below a water evaporation of 2.0 tons per hour. The writer has been informed that this apparent inconsistency may be explained by the fact that the smaller units are less expensive per ton of water evaporated, due to a sacrifice in efficiency which reduces the equipment cost.

Total Installation Cost Comparisons:

Total installation costs of the various types of plants are shown in Figures 6 to 9 inclusive. Primary treatment costs as plotted in Figure 6 shows that for plants of less than 10 m.g.d. capacity the installation costs of raw sludge incineration plants are highest, regardless of whether or not the high peak loads are obtained. These are followed by digested sludge incineration, covered and open drying beds and digested sludge filtration in the order named. In the larger plants, raw sludge incineration with 375 per cent peak loads is still the most expensive system. This is now followed by covered and open beds, digested sludge incineration, raw sludge incineration with 125 per cent peak loads and finally digested sludge filtration which persists at the lowest level throughout the entire range of plant sizes.

The same trends are noted for trickling filter and chemical treatment installation costs as shown in Figures 7 and 8, respectively. In the case of Figure 9, showing activated sludge treatment costs, however, a difference is noted in that while for plants below 5 m.g.d. capacity the same relationships hold as before, there is a change in order, starting at the 10 m.g.d. plant. Here, digestion with covered drying beds is the most expensive plant. This is followed by digested sludge incineration, raw sludge incineration, open beds, and digested sludge filtration. Above 25 m.g.d. raw sludge incineration with 125 per cent peak loads is less expensive than digested sludge filtration while covered drying beds are the most expensive.

It has long been known that digested activated sludge is relatively difficult to economically dewater on vacuum filters. In view of this difficulty the natural solution in the larger plants would appear to comprise a system wherein only the primary sludge is digested and the resulting digested sludge mixed with undigested activated sludge that has been previously subjected to a thickening operation. The resulting combination may then be dewatered. Curves showing the costs of such an arrangement with and without incineration are given in Figure 9. These show that the lowest cost plant is obtained where the combination is filtered. Incineration, if included, brings the overall cost lower than when all the sludge is digested and incinerated, but higher than where raw sludge incineration is assumed with only 125 per cent peak loads.

In all of the foregoing total plant cost comparisons, it is noted that there is a sharp break at 10 m.g.d. in the curves of raw and digested sludge incineration where 125 per cent of the daily average peak loads of solids are assumed. This is due to the fact that below 10 m.g.d., 8 hours' operation of filters and incinerators are assumed while above 25 m.g.d., the operation is continuous, i.e., 24 hours per day, sufficient time being taken out for filter cloth cleanings, etc. This appreciably reduces the proportionate cost of equipment for the larger plants.

Where 8 hour operation of filters and incinerators are assumed, they are designed to handle only 125 per cent of the daily average sludge load, even where 375 per cent raw sludge peak loads may be obtained. In such cases, the peaks may be satisfactorily handled by resorting to continuous 24 hour operation until the peaks subside. Where 24 hour operation is assumed, however, the filter and incinerator plants must be trebled to take care of the high peak on raw sludge.

Operating Costs

The schedule of operating charges used in this analysis is shown in Table 3. These require no further comment other than to point out that sludge removal and haulage charges may be representative for very large plants where there is no local demand for the sludge as a fertilizer and where there are no available dumps close to the plant site. In some instances, especially in small and medium sized plants, the sludge cake is sold or given away after removal from drying beds while in others, the purchaser even removes the sludge when requested. In still other cases, the sludge is processed and sold at a higher price after removal from the filters or drying beds. In a general analysis of this kind, it is obviously impossible to take all of these variable factors into consideration. In analyzing any specific example, however, outlets for sale of sludge should be considered, as final sludge disposal may be a costly item.

TABLE 3—ANNUAL OPERATING CHARGES

Item	Charge
1. Fixed charges	7½% of total installation cost
2. Labor	60c per man-hour
3. Power	1c per kilowatt-hour; or, 2 mills per kilowatt-hour where digester gas is used for power
4. Chemicals	See Table 4
5. Fuel	4c per gal. of oil
6. Supplies	1½% of erected cost of equipment
7. Maintenance and repairs	2% of erected cost of equipment
8. Sand replacement	$1.15 per ton
9. Sludge removal from beds	50c per ton of sludge cake
10. Sludge of ash haulage	50c per ton

TABLE 4—SLUDGE CONDITIONER COSTS—MIDDLE ATLANTIC AND MIDWESTERN STATES

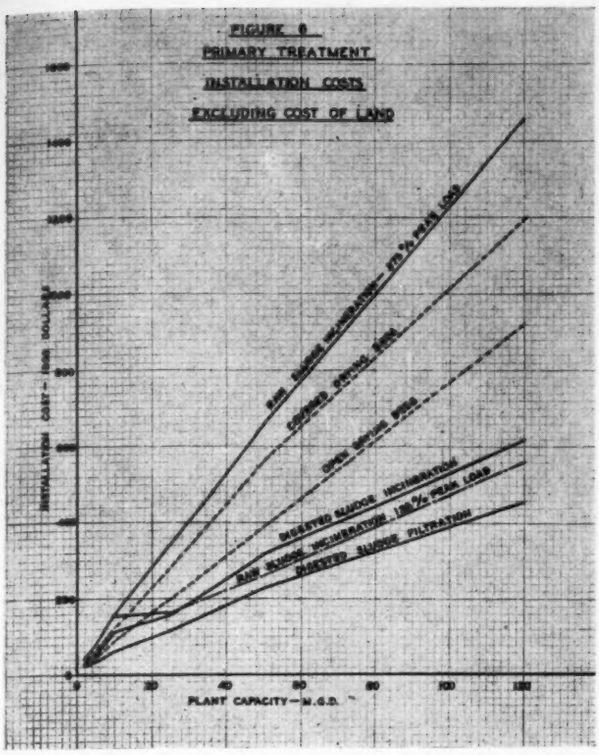
1. *Delivered Cost of Lime (CaO)*:
Freight, etc., taken at $4.00 per ton in carload lots (18 tons).
Freight, etc., taken at $8.00 per ton in less carload lots.
Maximum storage taken at 4 months.

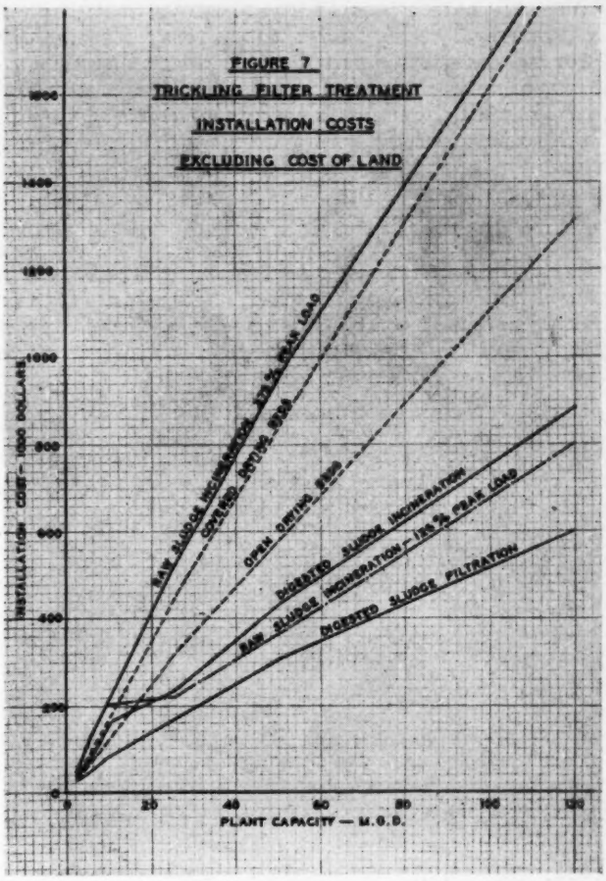
Amount Used Per Year	Cost Per Ton Delivered
Less than 120 tons (less carloads)	$20
120-1,000 tons (carloads)	12
Over 1,000 tons	10

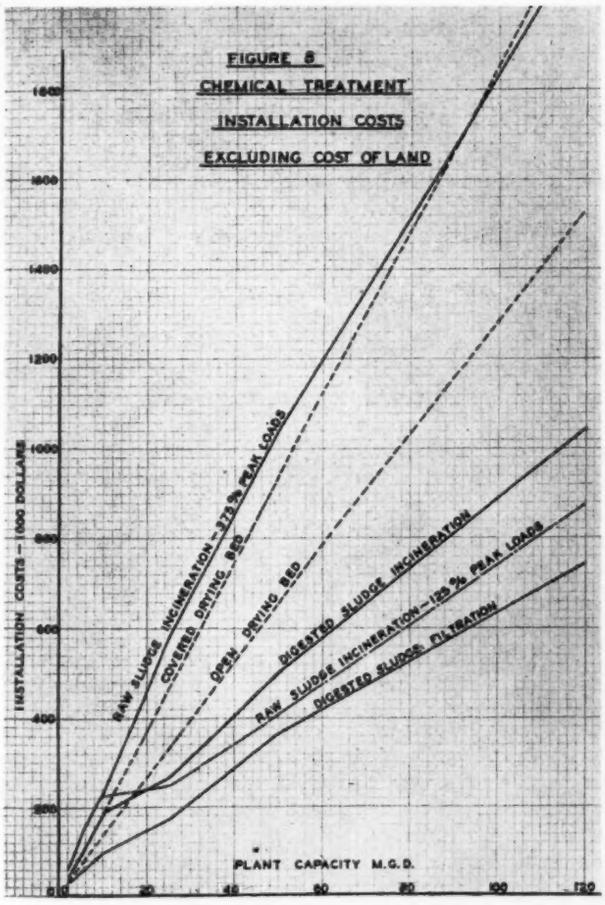
2. *Delivered Cost of Ferric Chloride* (Anhydrous basis):

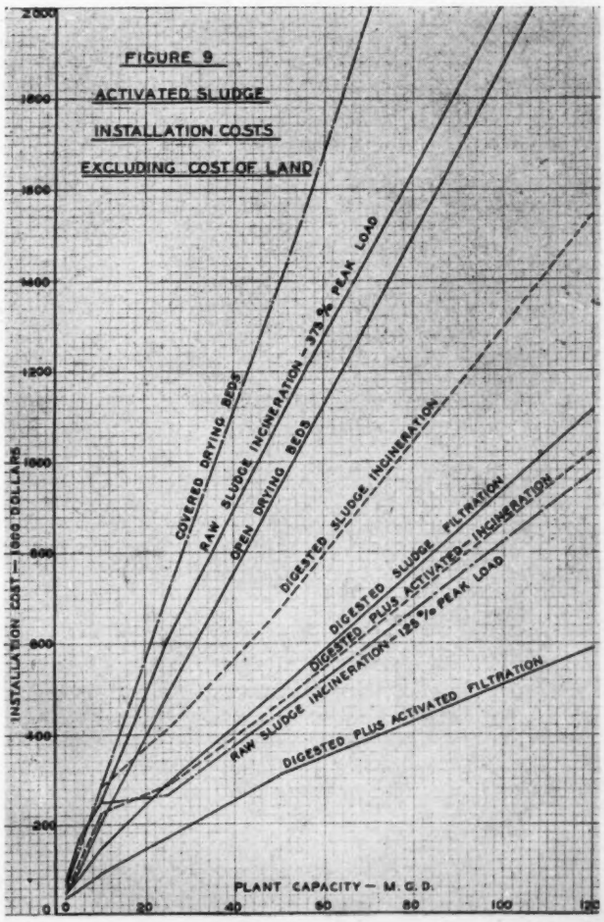
Type of Salt	Amount Used Per Year	Cost Per Lb. $FeCl_3$ Delivered, Cents
Anhydrous	Less carloads (1 T. min.)	4
Anhydrous	Carloads (18 T. minimum)	3.3
Liquid (40-45% $FeCl_3$)	40-100 tons (carload)	2.5
Liquid	100-1,000	2.15
Liquid	Over 1,000	2.0

Maximum storage of liquid ferric chloride taken at 6 months.
When the liquid is purchased it is assumed that there is a railroad siding at the plant site.









Figs. 6-9.—Total Costs of Various Types of Plants.

Where an excess of gas is available over that required for incineration, it is considered as being available for power by the use of gas engines. According to Walraven[2], operating costs, including 12 per cent of equipment costs for fixed charges, at Springfield, Ill., amount to 0.13 cents per kw. hr. of power generated. Adding fixed charges for a generator and other electrical control devices brings this cost of power generation to 0.20 cent per kw. hr. of power input.

Table 4 shows costs of lime and ferric chloride. Here again local conditions are an important consideration, especially in regards to the price of ferric chloride or other iron salts. Examples of variations in the price of ferric chloride are given in the following schedule showing some 1935 prices.

ANHYDROUS FERRIC CHLORIDE

Less Carload Prices (1 Ton Minimum):		*Carload Prices* (18 Tons Minimum):	
Ohio	3.5c per lb.	Maryland	3.15c per lb.
Wisconsin	4.13c per lb.	North Carolina	3.33c per lb.
Eastern New York	4.25c per lb.	South Dakota	3.40c per lb.

LIQUID FERRIC CHLORIDE (Tank Cars)

Location	Approx. Tons Per Year	Cost Per Pound ($FeCl_3$)
Dearborn, Mich.	500–1000	1.50
Milwaukee, Wisc.	2000	1.92
Chicago, Ill.	500	1.99
Central Illinois Plant	40	2.40

All prices quoted are delivered prices. In the case of Dearborn there is no freight added because of nearby production and truck delivery. From this, it can be seen that the price of ferric chloride depends on geographical location, amount of ferric chloride required per year, and whether or not there is a railroad siding at the plant to permit ready unloading of the liquid.

For the purpose of this analysis it is assumed that there is a railroad siding at all except the 2 and 5 m.g.d. plants. It is also assumed that where the yearly tonnage is between 18 and 40 tons the 3.3 cents per pound rate will apply.

Table 5 gives a schedule of labor, power and fuel requirements. The power and fuel requirements for incineration are based on Dearborn published results.[3] Additional fuel has been added as shown for start-ups, etc.

TABLE 5—OPERATING CHARGES—LABOR, POWER AND FUEL

Item	Quantity					
	Man-Hours Per Day					
Labor:	2 mgd	5 mgd	10 mgd	25 mgd	50 mgd	100 mgd
Thickeners	4	4	4	12	12	24
Digesters	8	8	8	24	24	36
Miscellaneous	4	8	8	16	16	32
Vacuum filters	1 man-hour per hour operation of one unit. ¼ man-hour per hour operation of each additional unit.					
Incinerators	1 man-hour per hour operation of one unit. ½ man-hour per hour operation of each additional unit.					
Power:	K.W. Hours Continuous					
Diameters	20 ft.	40 ft.	60 ft.	80 ft.	100 ft.	
Thickeners	0.23	0.46	0.68	0.80	102	
Digesters	...	1.1	2.2	4.4	6.6	
Sludge pumps	2.24 kw. at 50 g.p.m. 30 ft. total head.					
Vacuum filters	6.5 kw. per 100 sq. ft. filter area.					
Incinerators	6.875 kw. per ton of water evaporated.					
Power credit for digester gas	1 B.H.P. hr. per 18 cu. ft. gas.					
Fuel: 5.94×10^6 B.T.U.'s per ton of water evaporated. Add for start-ups, etc., 2.5 gals. oil/m.g. in 2, 5, 10 m.g.d. plants. Add for start-ups, etc., 0.2 gals. oil/m.g. in 25, 50, 100 m.g.d. plants.						
Heat Credit for Sludges: 10,000 B.T.U.'s per pound of combustible matter.						
Heat Credit for Digester Gas: 650 B.T.U.'s per cu. ft. gas.						

TABLE 6
OPERATING CHARGES—SLUDGE OR ASH DISPOSAL

	Primary	Trickling Filter	Chemical	Act. Sludge	Digested Raw Plus Undigested Activated
Sand Replacement: Tons sand/yr./mgd.	7	9	11.5	14.8	...
Sludge Quantities: Cu. yds./yr./mgd. (55 lbs. per cu. ft.)					
Sand Beds	340	436	554	724	...
Vacuum Filters	510	720	860	1136	1076
Ash Quantities: Cu. yds./yr./mgd. (45 lbs. per cu. ft.)					
Raw Sludge	130	166	216	162	...
Digested Sludge	110	144	196	162	...

Note.—Dry solids in filter cake equals digested sludge solids, plus 1.78 per cent for each per cent CaO added, plus 0.65 per cent for each per cent $FeCl_3$ added as conditioner.

Ash solids equals sludge ash plus 1.0 per cent for each per cent CaO added, plus 0.50 per cent for each per cent $FeCl_3$ added as conditioner.

Table 6 gives a schedule of sand replacement, sludge and ash quantities. Sand quantities have been figured on the basis of the loss of 1/16th inch of sand during each sludge removal. The wet sludge from the digesters is considered as being applied to a depth of about 12 inches.

Total Operating Cost Comparisons

Operating cost comparisons of the various plant arrangements are shown in Figures 10 to 13 inclusive. The primary treatment cost figures as plotted in Figure 10 show that raw sludge incineration, whether or not high peak loads are assumed, results in the highest operating costs for the entire range of plant sizes. In the 2 and 5 m.g.d. plants, open and covered sand bed drying bed costs are lowest, while in the larger plants digested sludge filtration or filtration with incineration appear to be the preferred arrangement from the standpoint of operating costs. In no case has the interest or cost of land been included in these figures. This item does not amount to an appreciable figure except where sand bed drying of sludge is used in the larger plants.

The same trend is noted for trickling filter and for chemical treatment operating costs, as shown in Figures 11 and 12 respectively. The costs for activated sludge treatment given in Figure 13 also follow the same general trend as in the other cases. In addition, however, they show that filtration or filtration and incineration of a mixture of digested primary and undigested (thickened) activated sludge give a much lower operating cost than the other mechanical methods especially in the high plant capacity range.

Whether or not the sludge mixture may be disposed of on dumps without odor nuisance is still a debatable question. Small scale tests indicate that this might be done without difficulty. Until this is demonstrated on a large scale, however, this particular system is not recommended, so that the lowest cost operation where open sand beds are not desired is to use filtration of the digested mixed sludges for plants below 15 m.g.d. capacity and incineration of the digested primary and undigested activated sludge mixtures above this point.

Figures 14 and 15 show break down operating costs of the various operations used in raw and digested sludge incineration plants for handling primary sludge only. The miscellaneous item covers the cost of ash disposal, sludge pumping, and miscellaneous labor.

These figures show conclusively that the cost of sludge

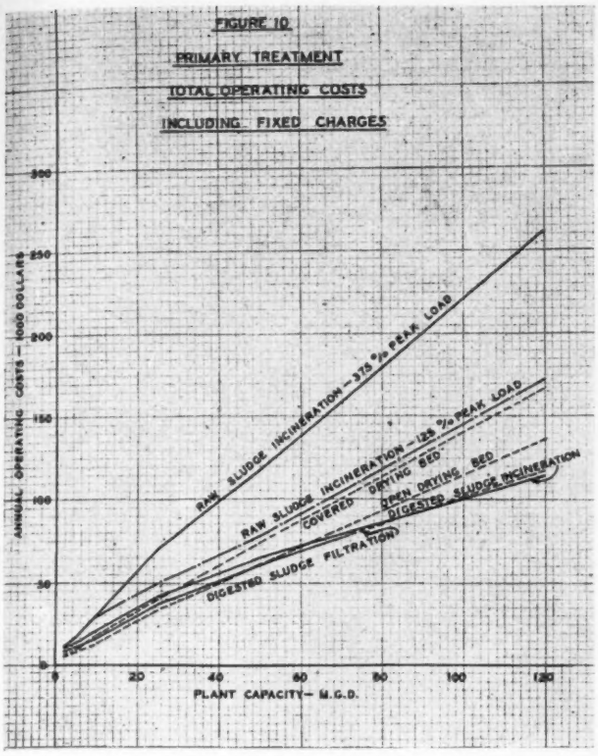
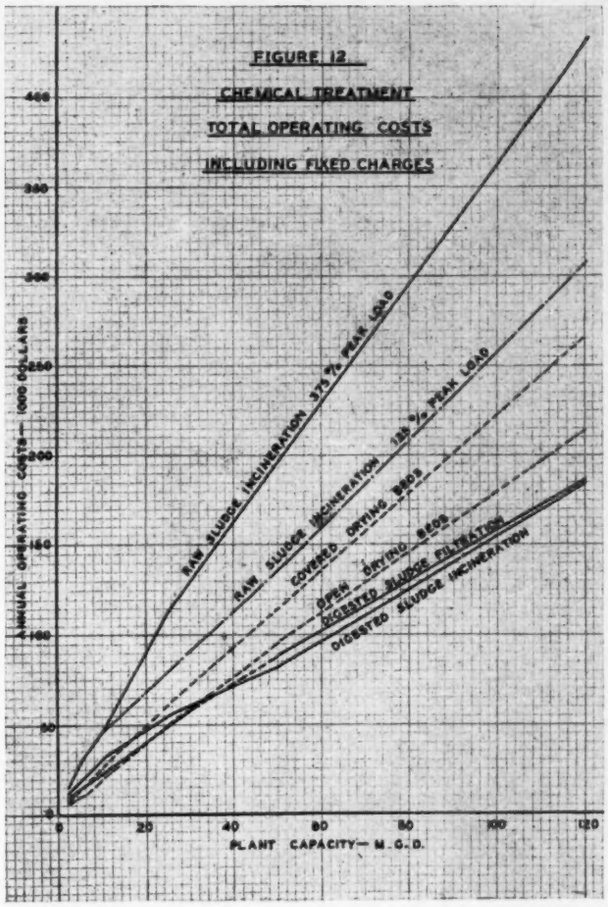


FIGURE 10
PRIMARY TREATMENT
TOTAL OPERATING COSTS
INCLUDING FIXED CHARGES
ANNUAL OPERATING COSTS — 1000 DOLLARS
RAW SLUDGE INCINERATION — 375 % PEAK LOAD
RAW SLUDGE INCINERATION — 125 % PEAK LOAD
COVERED DRYING BED
OPEN DRYING BED
DIGESTED SLUDGE INCINERATION
DIGESTED SLUDGE FILTRATION
PLANT CAPACITY — M.G.D.



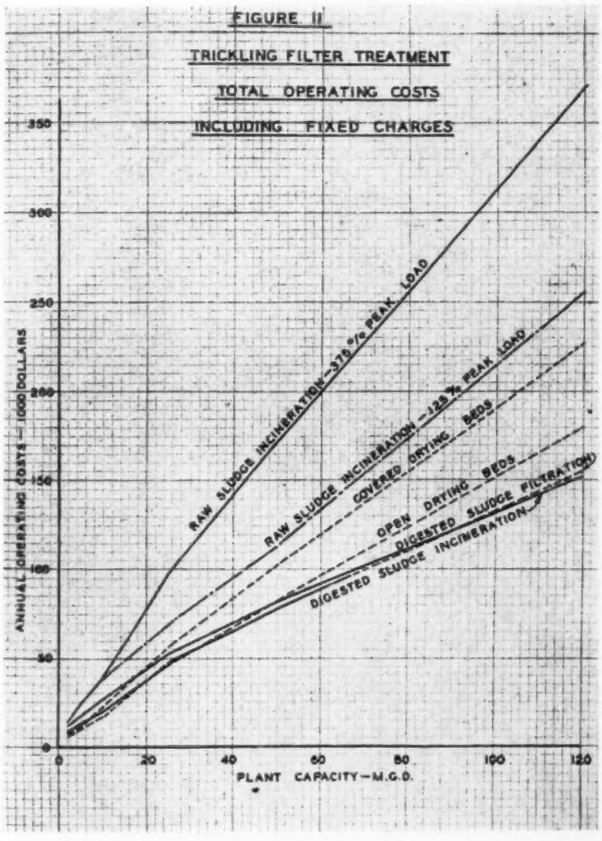
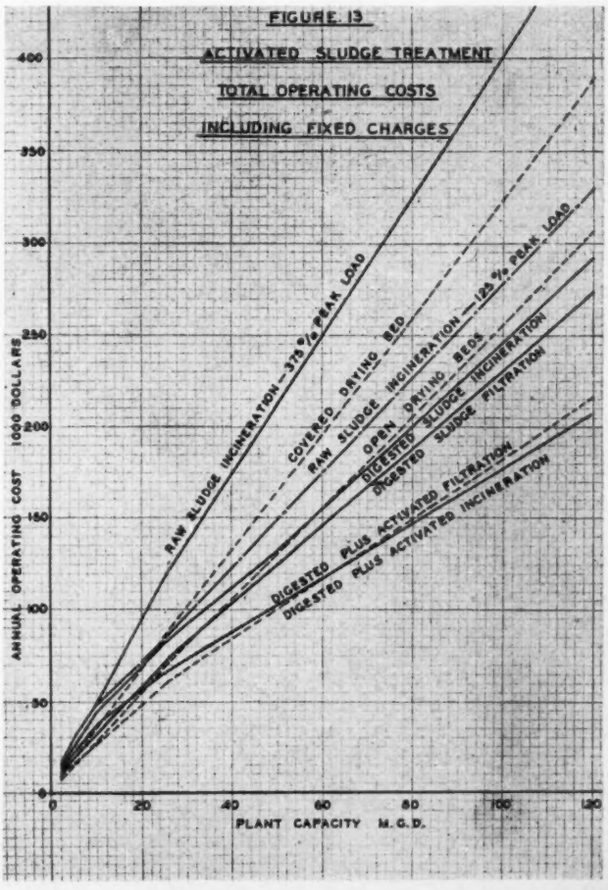


FIGURE 11
TRICKLING FILTER TREATMENT
TOTAL OPERATING COSTS
INCLUDING FIXED CHARGES
ANNUAL OPERATING COSTS — 1000 DOLLARS
RAW SLUDGE INCINERATION — 375 % PEAK LOAD
RAW SLUDGE INCINERATION — 125 % PEAK LOAD
COVERED DRYING BEDS
OPEN DRYING BEDS
DIGESTED SLUDGE FILTRATION
DIGESTED SLUDGE INCINERATION
PLANT CAPACITY — M.G.D.



Figs. 10-13.—*Operating Costs of Various Types of Plants.*

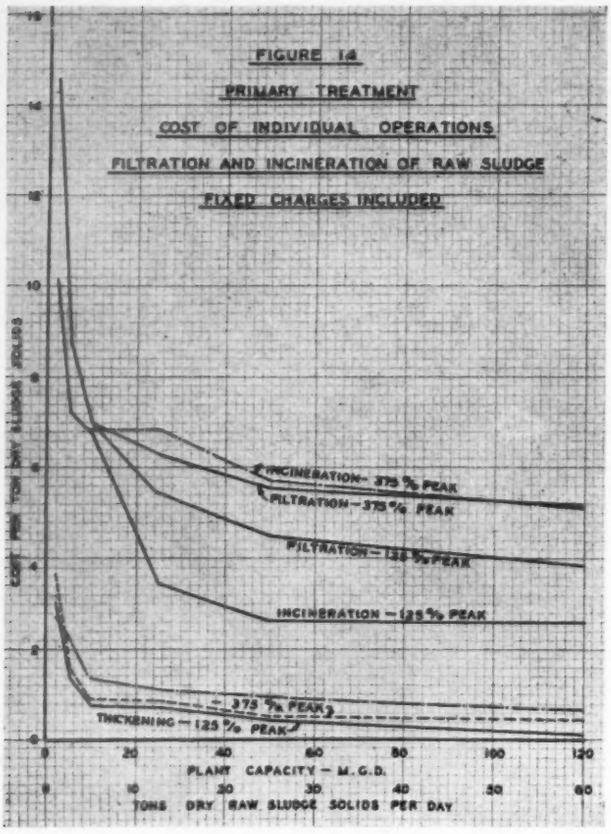
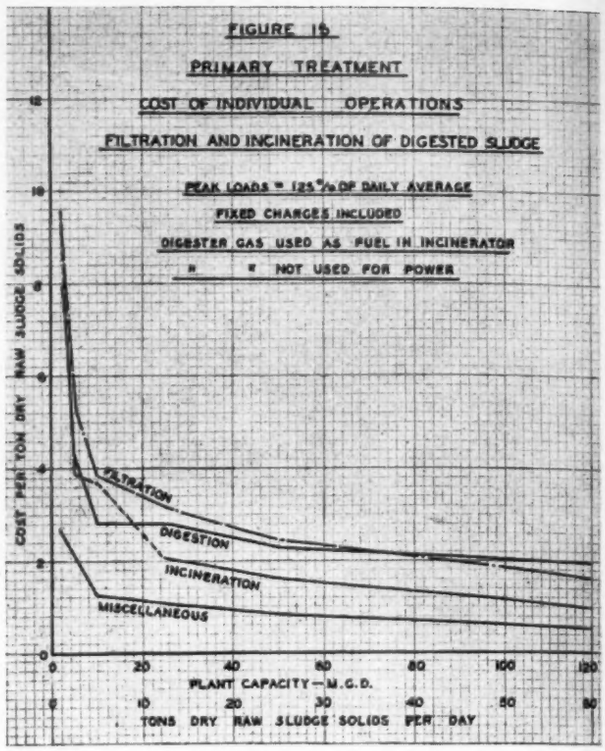


FIGURE 14
PRIMARY TREATMENT
COST OF INDIVIDUAL OPERATIONS
FILTRATION AND INCINERATION OF RAW SLUDGE
FIXED CHARGES INCLUDED
INCINERATION - 375 % PEAK
FILTRATION - 375 % PEAK
FILTRATION - 125 % PEAK
INCINERATION - 125 % PEAK
THICKENING - 375 % PEAK
THICKENING - 125 % PEAK
PLANT CAPACITY - M.G.D.
TONS DRY RAW SLUDGE SOLIDS PER DAY



Figs. 14 *and* 15.—*Break Down of Operating Costs—Digested vs. Raw Solids Incineration.*

filtration and incineration are greatly reduced by digestion, the reduction being far greater than the additional operating costs of the digesters. Savings in power costs by the use of digester gas for power are not deducted in the case of digested sludge.

Additional Cost Reductions

Additional savings in installation and operating costs may be effected in the case of digested sludge handling by resorting to short-time or partial digestion. It has been demonstrated on a plant scale that a 20 day digestion period will suffice for the stabilization of primary and mixed sludges. It has further been shown that the filtering qualities of the sludge might be improved by resorting to these shorter periods rather than going to extremely long periods now in general use. In this regard, thermophilic digestion for 2 or 3 days followed by a secondary mesophilic period of 5 to 10 days has distinct possibilities, especially where activated sludge is being handled.

Elutriation of sludge in accordance with the process developed by Genter at Baltimore also appears to have good possibilities, especially on digested sludge as shown by a long series of semi-plant scale tests. Published data by Keefer[4] shows that a 6 lb./sq. ft./hr. filter rate may be obtained using elutriation with only 1 per cent $FeCl_3$ as conditioner. Figure 16 shows the increase in plant installation costs and the net decrease in operating costs for plants using the process. The installation costs includes present royalty charges, and the installed costs of additional equipment for a 2-stage counter current washing system. From the savings in chemical costs have been deducted, fixed charges and costs of power, supplies, maintenance and repairs for the additional equipment required.

Genter[5] states that in later laboratory tests he has obtained a further reduction of ferric chloride to ½ per cent by improved sludge washing. He also claims that the same filter rates can be obtained when using 1 per cent alum.

Present Status:

The first experimental work on vacuum filtration of raw, digested and mixed sludges was carried out by the writer at Salem, Ohio, on a semi-plant scale in 1929. Since then experimental semi-plant or large scale results have been obtained at Los Angeles, North Toronto, Columbus, Baltimore, Chicago, Palo Alto and Cleveland on a variety of sludges. At the present time, however, the only regularly operating plants besides those operating on straight activated sludge, are as follows:

Plant	*Type of Sludge*
Springfield, Ohio	Digested primary
Columbus, Ohio	Digested primary (Imhoff tank)
Cedar Rapids, Ia.	Digested (primary, plus trickling filter plus chemically precipitated packing house waste)
Dearborn, Michigan	Semi-digested primary plus chemically precipitated
Perth Amboy, N. J.	Raw primary or chemically precipitated
Hagerstown, Md.	Raw primary or raw primary plus activated
Great Neck, L. I.	Raw primary or chemically precipitated
Oklahoma City, Okla.	Raw primary plus chemically precipitated
Rockford, Mich.	Raw primary plus tannery waste
Rockville Center, L. I.	Raw primary plus activated
Winston-Salem, N. Car.	Chemically precipitated

Plants under construction or definitely under contract are:

Plant	*Type of Sludge*
Washington, D. C.	Elutriated digested-primary
Coney Island, N. Y.	Digested (primary and chemical)
Annapolis, Md.	Digested primary
Kokomo, Ind.	Digested primary
Ann Arbor, Mich.	Digested (primary and activated)
Chicago, Illinois	Raw primary and activated
St. Charles, Illinois	Chemically precipitated
Auburn, N. Y.	Raw primary and chemically precipitated

Sludge incineration was first successfully demonstrated by the Chicago Sanitary District in 1932. At the present time the only sludge incinerator in operation is at Dearborn, Michigan. Other units under construction or under contract are those for Chicago, Kokomo and Auburn on the types of sludge as noted above.

Future Trend:

The large number of vacuum filter installations operating or under contract indicates a definite trend toward this method of sludge dewatering as against sand drying beds. A large enough number of incinerator plants have not yet been contracted for to indicate exactly where they will fit in the field of sewage treatment. From this cost analysis it appears that their greatest field will be in the range of the large plants (specifically above 25 m.g.d.) and in the smaller plants where no sludge dumping facilities are available and where there is no local market for the sale of sludge as a fertilizer. Local factors will exert a considerable influence on the method of treatment adopted in each case, but digested sludge incineration appears to be more desirable than raw sludge incineration with a distinct tendency toward short-time digestion periods. An exception is the case of activated sludge treatment where incineration of the digested primary and concentrated (thickened) undigested activated sludge may be more economical.

Where there is a considerable local market for the sale of sludge as a fertilizer present types of incinerators may be modified so that they can be used as dryers or as combination dryers and incinerators at will.

Summary and Conclusions:

1. An economic study has been made comparing installation and operating costs of various methods of sludge disposal where primary, trickling filter, chemical and activated sludge treatment are employed.

2. Peak loads are a very important factor and must be taken into consideration, especially where raw sludges are filtered and incinerated direct. In such cases, a two-day sludge storage or thickening period is advisable, and excess filter and incinerator capacity may have to be furnished to handle three to four times the *daily average* dry solids load.

3. Installation costs are highest where peak loads of 375 per cent of the daily average dry solids load are assumed.

4. For all plant sizes, raw sludge incineration first costs using only 125 per cent peak loads are higher than those for digested sludge filtration without incineration. They are slightly lower, however, in the case of plants of over 15 m.g.d. capacity, than where digested sludge is filtered and incinerated; or, where mixed digested primary and undigested activated sludge is filtered and incinerated.

5. Installation costs are lowest where all of the sludge is digested prior to dewatering on vacuum filters. An exception is the case of activated sludge treatment, where filtration of the combined digested primary and thickened undigested activated sludges gives the lowest first cost.

6. Operating costs of raw sludge incineration plants are highest even where only 125 per cent peak loads are assumed.

7. Operating costs are lowest for plants of less than 10 m.g.d. capacity where open sand drying beds are used. In general, for plants of over 25 m.g.d. capacity the costs of digested sludge filtration or filtration with incineration are lowest.

8. In the case of activated sludge treatment the desirable procedure from an operating cost standpoint is to combine the digested primary and the thickened undigested activated sludges prior to filtration or filtration with incineration.

9. Operating costs may be reduced considerably in the case of digested sludge handling by resorting to shorter digestion periods (20 days) and by using the elutriation or sludge washing process as developed by Genter.

10. Future trends appear to be toward vacuum filtration of sludges in the smaller plants, with a possibility of drying the sludge cake for local marketing as a fertilizer. In the larger plants, sludge incineration will find a more widespread application.

11. The findings and conclusions arrived at are based on the exact conditions and costs as noted in this paper. They are not intended to cover all conditions. In general, each specific problem must be analyzed on its own merits, taking into consideration the various influencing local factors.

REFERENCES

1. Allton, R. A.—Private communication.

2. Walraven, W. B.—Power Production From Sludge Gas at Springfield, Illinois; WATER WORKS AND SEWERAGE, May, 1933.

3. Owen, M. B.—Sludge Incineration at Dearborn; WATER WORKS AND SEWERAGE, August, 1935.

4. Keefer, C. E.—The Vacuum Filtration of Elutriated Sludge; *Sewage Works Journal*, September, 1934.

5. Genter, A. L.—Private communication.

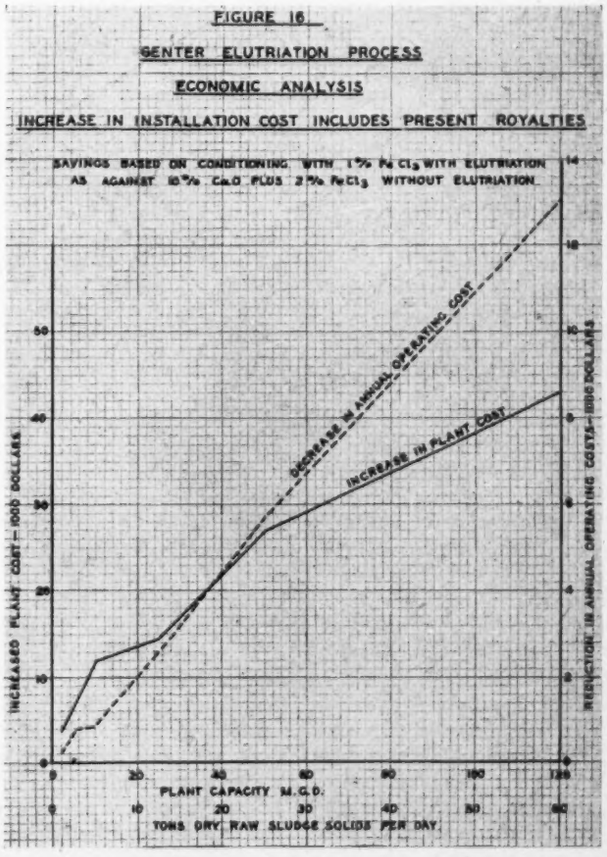


FIGURE 16
GENTER ELUTRIATION PROCESS
ECONOMIC ANALYSIS
INCREASE IN INSTALLATION COST INCLUDES PRESENT ROYALTIES
SAVINGS BASED ON CONDITIONING WITH 1% Fe Cl3 WITH ELUTRIATION AS AGAINST 10% Ca.O PLUS 2% Fe Cl3 WITHOUT ELUTRIATION
DECREASE IN ANNUAL OPERATING COST
INCREASE IN PLANT COST
INCREASED PLANT COST — 1000 DOLLARS
REDUCTION IN ANNUAL OPERATING COSTS — 1000 DOLLARS
PLANT CAPACITY M.G.D.
TONS DRY RAW SLUDGE SOLIDS PER DAY

Fig. 16.—Economic Analysis of the Genter Elutriation Process.

REGULATING WATER PIPING WITHIN BUILDINGS

By STEPHEN H. TAYLOR
Superintendent, Water Department, New Bedford, Mass.

The Author

IT is the opinion of the writer that sufficient attention has not been given in the past by water works officials to water piping and fixtures inside of the taker's premises.

Until last year, we in New Bedford have felt that when we assured ourselves that the service pipe to and including the meter were of proper material and properly installed our responsibility and jurisdiction ended; and, what was installed inside of that point was wholly the affair of the owner and his plumber. I think it is safe to say that most water works officials in this country have taken the same attitude.

In consequence, we find in many cases that faulty workmanship has been a result and inferior materials have been installed. In addition, sanitary fixtures are often of a design and so installed as to unwittingly introduce a danger to health through pollution of the water supply within buildings by siphonage or gravity backflow of polluted water from bowls and other fixtures to the water supply piping. Speculative and boom building has resulted in many buildings being piped with cheap materials and fixtures, installed frequently by incompetent workmen.

It is a well known fact that the surface water supply of New Bedford is rather active and quickly fills wrought iron and steel pipes with rust and tubercles. This condition exists also in many other communities. In spite of such knowledge, many buildings have been piped with this type of material, with the result that after comparatively few years, water cannot be drawn through more than one fixture at a time and that one delivers only a weak supply. Services installed by the Water Department in New Bedford are of lead, in sizes up to 1 inch; and, copper or cast iron is employed for the larger sizes. In most cases we have installed the service up to the meter, which is usually located in the cellar of the building.

When complaints of poor flow come to us we clear the tap and service line, if necessary, and prove that the supply is ample up to the meter and that the trouble is caused by rust choking of the steel piping inside the building. This means many unnecessary visits and explanations; which takes considerable time of our employes. When the owner finds that his only remedy for the trouble is to repipe the entire building, to say that he is somewhat disturbed, is stating the case mildly.

We have also found that modern fixtures frequently of such a design that polluted water from them can flow back into the water supply pipes either by gravity or siphoning in case the pressure is reduced by heavy draught on the lower floor of buildings, or wherever the water is shut off in either the building or in the street.

Water Board Drafts Regulations

In an effort to improve these conditions the Water Board adopted a set of rules and regulations, which became effective June 1, 1935, governing the installation of house piping, which we feel will benefit the water department—but, more especially the public.

The city ordinances place the supervision of hot water tanks and water heaters under the jurisdiction of the City Board of Health. That department works in cooperation with our department regarding this equipment and has established rules which require that such equipment be installed in a manner which will be safe and prevent forcing hot water back to damage meters.

The new regulations follow.

[Note.—At this point the author outlined those parts of the regulations which embrace the principal requirements pertaining to "Inside Piping and Fixtures." Believing that our readers may prefer to have before them the completed set of regulations, these are reproduced below (in full) just as they appear in the neat little brown booklet (3¾ x 6 in.) which is distributed by the New Bedford Water Department.—Editor.]

New Bedford Water Board Regulations

Governing Water Service Supply Piping and Fixtures*

June 1, 1935

(See separate pamphlet for sprinkler piping regulations)

Section I. Every water-taker shall pay the established rates for water supplied within the time and at the place specified upon bills rendered; shall at his own expense, keep the service pipes within his premises in good order and repair and protected from the frost; shall not allow the water to run to waste; shall not make any change in the service pipe between city main and meter, unless sanctioned so to do by the superintendent; shall not conceal the purpose for which water is used; shall allow the superintendent, registrar and persons authorized by them, or by the board to enter the premises supplied with water to examine the pipes and fixtures and ascertain the quantity of water used and manner of use, and shall indemnify the city for all damages it may sustain or be required to pay, in consequence of any injury resulting from any violation of these regulations by the water taker.

Section II. All applications for service supplies must be made by the owner of property at the office of the registrar in the form prescribed, stating the various uses to which the water is to be applied.

Section III. SERVICE FROM STREET—In every case the installation of the service pipe from the street main to the end of pipe where taker's stop with waste is installed by the plumber shall be made by the New Bedford Water Department and the charge to the owner shall be as specified in regulation adopted by the Water Board February 6, 1924, viz.:

For installing one service to each property from the main pipe to street line as follows:

For ⅝ in. service	$31.00
For ¾ in. service	32.00
For 1 in. service	39.00

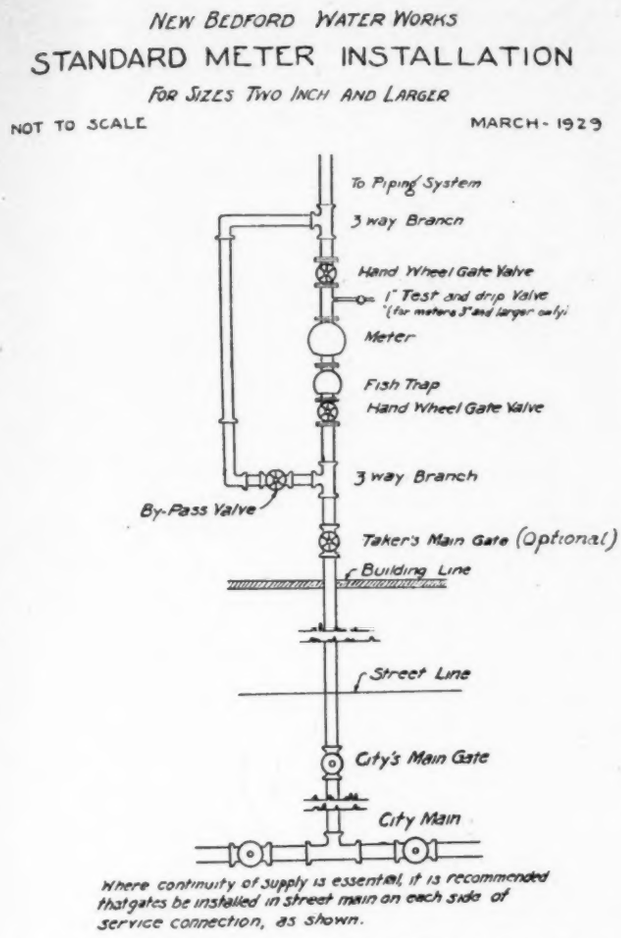
In cases where permanent pavement is disturbed, the owner is also required to pay for replacing the same.

For secondary services, temporary services or for services larger than one inch in size, the entire cost of installation, including cost of re-surfacing permanent street pavement.

For all services on private property, the owner shall pay the entire cost of such work.

Section IV. Each service shall be provided with a satisfactory stop and waste cock with coupling (this stop shall be

*Regulations pertaining to inside piping and fixtures begin with Section VIII.


NEW BEDFORD WATER WORKS
STANDARD METER INSTALLATION
FOR SIZES TWO INCH AND LARGER
NOT TO SCALE
MARCH - 1929
To Piping System
3 way Branch
Hand Wheel Gate Valve
1" Test and drip Valve
(for meters 3" and larger only)
Meter
Fish Trap
Hand Wheel Gate Valve
3 way Branch
By-Pass Valve
Taker's Main Gate (Optional)
Building Line
Street Line
City's Main Gate
City Main
Where continuity of supply is essential, it is recommended that gates be installed in street main on each side of service connection, as shown.

Standard Meter Installation, New Bedford Water Works

round way and of the same size as the service pipe) to be located always just within the basement wall, at the point where the service pipe enters, and the pipes within the building must be so arranged that the water can be drawn from them whenever there is danger of freezing. The department will not be liable for any damage resulting from a failure to observe this important rule.

Section V. No water-taker shall be entitled to any damages nor will any portion of a payment be refunded for any sudden stoppage of the city supply occasioned by an accident or otherwise, nor for any stoppage for the purpose of making extensions, alterations or repairs. In such an event the water-takers must guard themselves against the collapse of boilers and other injuries liable to result from stoppage of the water supply.

Section VI. No cross connections between the City supply and any other supply which is not approved as potable by the State Dept. of Public Health shall be permitted except those which are properly protected by double check valves of an approved type. Said check valves shall be approved by the Water Board and shall be regularly inspected at the expense of the owner of the property by a representative of the Water Department at such intervals as the Water Board shall determine.

Section VII. METER REGULATIONS.

a. One meter of standard type and of same size as the supply pipe must be installed upon each service connection. It may be located between the curb stop and building or within building. If within building, it must be placed at a point adjacent to shut off, where pipe enters through foundation wall. If outside the building, it shall be installed in a satisfactory box or pit not less than 3 ft. x 4 ft. x 4 ft. deep. All meters 2 inches or larger shall be equipped with a by-pass capable of supplying the premises when the meter is removed for repairs or test. This by-pass valve to be kept sealed shut except when meter is out. (See Sketch.)

b. In all cases where one service connection supplies two or more separate consumers, or a block occupied by divers parties, only one meter will be used and the water rent as registered by said meter shall be charged to and payable by the owner of said premises or building. If additional meters are desired to ascertain sub-division or such supplies, they will be furnished at the expense of the applicant, who must assume all responsibility of reading and maintaining same.

c. Owners of property will be given option of either purchasing a meter outright and paying for its installation, or of having city furnish and install same and paying an annual rental therefor.

d. The property owner must keep the meter within his premises easily accessible for reading at all times. The city will include all repairs due to ordinary wear in its rental charge, but in all such cases, the owner will be held responsible for proper protection of the meter from all damage which may occur due to freezing or from hot water backing from overheated house boilers or other causes. Property owners will be assessed the cost of repairs of every nature necessary to properly maintain the meter owned by them. In case payment of such charges is not made upon demand, the water will be shut off from the premises supplied, and will not be renewed until after such charges, including the additional sum of one dollar, to cover expenses of shutting off and letting on the water, shall have been paid.

e. The owner of property shall pay at the established meter rate for amount registered, whether used or wasted. The water department will not assume any responsibility for use of water within metered premises.

f. Should a meter fail to register for any cause, the quantity shall be determined and the charge made based on average amount registered by meter when in order.

g. After a meter has been installed, it will not be removed for purpose of rating the premises supplied on any other basis of water charged.

h. No meter shall be discontinued from the pipe, moved or disturbed, without permission from the water registrar, who will send a properly authorized person to attend to any change needed.

i. If a house becomes unoccupied, the owner or agent may have the water shut off and the meter removed during the period of non-occupancy by making a request therefor to the water department, and paying one dollar to cover expenses.

Section VIII. PLANS TO BE APPROVED—Plans of proposed new installations, extension or alteration of existing systems, showing proposed sizes and materials, must be filed with the Water Board, and approved by said Board or its designated representative before starting work.

Section IX. INSIDE PIPING—All inside installations shall be made under the direction of a registered Master Plumber, except in manufacturing plants or other plants where competent pipers are regularly employed. Connections to supply water heaters, hot water storage tanks, heating and ventilating apparatus, cooling systems and power plant equipment and apparatus may be made by competent employes of persons regularly engaged in the business of installing such apparatus, subject to the inspection and approval of the Water Board. Each holder of a Master Plumber's Certificate of License shall register his name and business address with the Water Board on or before the first day of May in each year. Notice of any change in the place of business shall be given immediately to said Water Board.

Section X. INSPECTION AND TEST—On completion of the installation it shall be inspected and approved by the designated inspector of the Water Board before the water supply will be turned on to the premises. It shall be tested in the presence of the inspector at city water pressure.

Section XI. KIND OF PIPE—All water supply pipes and fittings shall be of lead, brass, copper or other non-ferrous metal or composition, except in the case of pipes four inches or more in diameter, in which case, cast iron pipe properly coated and lined with material approved by the Water Board may be used.

In order that piping shall be sufficiently strong to withstand City pressure with a reasonable allowance for corrosion all pipes must comply with the following minimum specifications.

LEAD PIPE:

All lead pipe for water service shall be made from soft virgin pig lead without any admixture of scrap lead or any other material and shall weigh not less than

For	½ in. pipes	3	pounds per foot
For	⅝ in. pipes	3½	pounds per foot
For	¾ in. pipes	4½	pounds per foot
For	1 in. pipes	6	pounds per foot
For	1¼ in. pipes	7¾	pounds per foot
For	1½ in. pipes	11¼	pounds per foot
For	2 in. pipes	19½	pounds per foot

BRASS PIPE:

All brass pipe used for water supply piping shall conform with the Standard Specifications of the American Society for Testing Materials for "Brass Pipe, Standard Sizes" Serial

Designation B43-23, with the exception of Paragraph 4 thereof. In place of the said Paragraph 4, the brass shall conform to the following requirements as to chemical composition:

Copper, minimum	59.00%
Lead, maximum	0.50%
Iron, maximum	0.07%
Zinc, or Zinc and Tin	Remainder

This change admits use of so-called "Admiralty" and "Red" brasses.

COPPER PIPE:

All copper pipe used for water supply piping shall conform with the Standard Specifications of the American Society for Testing Materials for "Copper Pipe, Standard Sizes," Serial Designation B42-23.

COPPER TUBING:

All copper service tubing used for underground piping shall conform with the Standard Specifications of the American Society for Testing Materials for Copper Tubing, Government Type K, Serial Designation B88-33. For interior piping copper tubing, Government Type L, is allowable.

Fittings for use with brass or copper pipes shall be of material and strength corresponding with the pipe used. All installations shall be made in a thorough and workmanlike manner satisfactory to the New Bedford Water Board.

Pipes which are to be concealed in partitions or otherwise shall be tested as specified in Section X before being concealed.

No pipes which have previously been used for other purposes shall be used for distributing water.

Section XII. PROTECTION—All concealed water pipes, storage tanks, flushing cisterns, and all exposed pipes or tanks subject to freezing temperatures shall be efficiently protected against freezing.

Section XIII. DISTRIBUTION—The water supply shall be distributed through a piping system entirely independent of any piping system conveying another water supply.

Section XIV. WATER SERVICE—The water service pipe of any building shall be of sufficient size to permit a continuous ample flow of water to all fixtures on all floors at a given time.

Section XV. SUPPLY TO FIXTURES—All plumbing fixtures shall be provided with a sufficient supply of water for flushing to keep them in a sanitary condition and shall be adjusted to prevent waste of water. The water from water closet and urinal flush tanks shall be used for no other purpose.

The bottom of flush tanks for water closets or urinals shall be above the overflow level of the fixture when drain is obstructed.

All flushometer valves for water closets shall be equipped with a vacuum breaker of a type approved by the Water Board.

The supply pipe for each tenement or bathroom shall be not less than ½" inside diameter and connect to the main supply pipe, which shall be not less than the size of the main service. The main service shall be carried full size to the point where the last branch is taken off in the basement.

Accessible shutoffs with waste shall be provided in the basement which shall separately control the water supply for each tenement and for each hot water tank.

Section XVI. SIZE OF PIPES—The minimum size of water-service pipes from main to the dwelling shall be five-eighths inch, and to fixtures as follows:

Sill Cocks	½ in.
Hot Water Boilers	½ in.
Laundry Traps	½ in.
Sinks	½ in.
Lavatories	⅜ in.
Bath Tubs	½ in.
Water Closet Tanks	⅜ in.
Flushometer Valves for Water Closets	1 in.
Flushometer Valves for Urinals	½ in.

[Note: A copy of the application form, for Water Department approval of piping and fixture installations, may probably be had upon request to the author of this article—*Editor.*]

Some Results

It is interesting to note that in spite of the fact that no new building has been going on in New Bedford during the 8½ months since these rules became effective about 700 permits for alterations and replacements have been issued.

Two outstanding cases of potential pollution from back syphoning have recently come to the attention of our inspector. One was in a large High School; the other in a department store of importance. These cases and many others show the need of constant vigilance on the part of someone, and we in New Bedford have decided that the Water Department should assume this responsibility as there is a possibility that pollution from such sources may even get back into our mains by siphonage or gravity when it becomes necessary to shut off the street mains.

The inspection has been placed in the hands of a Master Plumber of long experience who has the respect and confidence of other master plumbers. He is a full time employee of the Water Board and has the complete cooperation of the plumbing inspector of the City Board of Health.

The new regulations have been in effect since June 1st, 1935, and the results have been very satisfactory. The master plumbers cooperate very well with us as it protects them against unfair competition of unlicensed men and inferior materials. The public gains by being assured of proper supply and approved water fixtures. The department gains by being relieved of many complaints which come about as the result of improper materials or workmanship.

As far as the writer knows, very few communities have made rules regulating water service piping and fixtures inside of buildings. No matter how complete the main distribution system and service connection may be, the consumer will not get the supply he is entitled to at his fixtures or the protection against pollution within his own property unless someone sees to it that proper interior piping and fixtures are installed in an approved manner.

Our City Solicitor has ruled that the supervision of the entire water supply (except water heaters and hot water tanks), up to and including proper fixtures, is within the jurisdiction of the Water Department.

Acknowledgment: The above article is composed of parts of a paper presented before the New England Water Works Association by the author—Feb. 20th, 1936. Discussion appears elsewhere in this same issue under the report of the above meeting.

▼

Florida Section A.W.W.A. to Celebrate 10th Anniversary

From Keith R. Chinn of West Palm Beach, Vice-Chairman and Acting Chairman of the Florida Section of A. W. W. A., comes an especially appealing invitation to come down to help the Florida Section celebrate its 10th Anniversary at its annual meeting to be held in Tampa, March 31st and April 1st and 2nd.

From Professor A. P. Black (University of Florida) comes an announcement which indicates that he is still a "Maestro" when it comes to putting on an interesting technical program and demonstrations. And, Secretary J. R. Hoy (Jacksonville), in his letter, must have been pinch-hitting for the Tampa Chamber of Commerce and Water Department combined.

From all this, one may be assured that these Floridians mean business when they say that the 10th Anniversary meeting of their section is to be something extra fine; and, knowing this trio, that has a genuine meaning. Those who can possibly afford the time will find a real treat and vacation in store for themselves if arrangements could be made to attend the Florida meeting March 31st and April 1st and 2nd (pay no attention to the April Fool Day). Then to meander through Florida's playland and up to historic St. Augustine and finally on to that most charming metropolis of the Old South—Savannah, Ga.—for Bill Weir's Southeastern Section Convention April 7th-9th.

But, watch out for that Florida sand: They say, if it gets into your shoes you can't stay away. There is something to it.

DETERMINING THE NECESSARY TREATMENT TO PREVENT CORROSION

By P. L. McLAUGHLIN
Sanitary Engineer,
West Virginia Water Service Co.,
Charleston, W. Va.

The Author

DIFFICULTIES from red water and corrosion have necessitated corrective treatment at nine of the fifteen water works plants owned by the West Virginia Water Service Company in the State of West Virginia. All of the supplies requiring such treatment are derived from "flashy" streams which flow through mountainous territory. Three of the plants take water from the Kanawha River, two from the Elk River and one each from the New River, the Little Kanawha River, the West Fork of the Monongahela River and Pond Fork of the Little Coal River.

The chemical characteristics of these streams are quite similar in respect to qualities associated with corrosion. For example, all are soft, having average alkalinities ranging from 10 to 40 p.p.m. The waters contain free carbon dioxide, have average pH values from 6.3 to 7.3 and are under-saturated with respect to calcium carbonate solubility. None of the supplies are subjected to pollution from acid mine drainage in any appreciable quantity.

Lime Treatment

All nine of the supplies considered are purified in rapid sand filtration plants. With one exception, wherein soda ash has to be used, hydrated lime is employed at every plant for the prevention of red-water and corrosion. Lime is applied to the filtered water in clear water wells at seven of the plants and to the settled water (filter influent) at the eighth, which is equipped with filters of the pressure type.

The results of corrective treatment have been very satisfactory and well worth the small additional cost. The Charleston plant, the largest operated by the Company in the state (16,000 consumers and 151 miles of mains), commenced the application of lime to the filtered water in the spring of 1930. Complaints of "red-water" fell off rapidly within a few weeks following inauguration of the treatment and after several months such complaints were seldom received.

Similar satisfactory experiences can be cited for the other plants using corrective treatment. Without exception, the managers of these properties report that present conditions are far superior to those experienced prior to the use of the treatment. Practically no complaints of red-water are received by them today except occasionally from consumers residing on dead ends of the distribution systems. Furthermore, all managers report the presence of a white film, or protective coating, in the pipes of their distribution systems, although the extent to which this coating has been deposited varies with the different waters and seems to be dependent upon the size of the distribution system, the length of time the treatment has been in use and the accuracy with which it has been carried out.

The Method Adopted

The treatment consists of producing a plant effluent which is in "chemical balance"; that is, at the saturation point with respect to its power to dissolve calcium carbonate. This procedure is based on accepted principles that a water which no longer dissolves calcium carbonate should tend to form a protective coating in the mains and thus prevent corrosion. Methods have appeared in water works literature which makes it possible for a plant operator to determine whether or not the water at his plant is in equilibrium with calcium carbonate; that is, will not dissolve calcium carbonate nor deposit to heavily on the mains. By cut and try methods, he can adjust the alkalinity of his plant effluent so that it is not corrosive nor overly incrusting. However, it is for the purpose of eliminating such trial methods that the writer uses the following procedure for rapidly determining, on a single sample of water, the correct pH to maintain through lime addition to that water to prevent corrosion.

The procedure adopted assumes that the degree of undersaturation or the degree of supersaturation (within the limits required for performance of the test), of a water at a given alkalinity and pH is a function of the degree of increase or the degree of decrease in the total alkalinity of that water after contact with an excess of pure $CaCO_3$. Therefore, to determine the pH value at which the saturation point of an undersaturated water is attained, it is only necessary to increase the pH of a sample of that water (with lime) through a series of arbitrary pH values. Then, determine the degree of undersaturation, or supersaturation, as expressed by parts per million gain or loss in total alkalinity after treatment with $CaCO_3$, of the samples treated to produce increasing pH values. The use of a graph is then resorted to and the differences in alkalinity are plotted against their corresponding pH values, the increases or decreases in alkalinity being chosen as the ordinates of the graph and pH as the abscissa. A curve is drawn through the plotted points. Where it intersects the axis of abscissas (the pH scale) is found the pH representing the calcium carbonate saturation point of the sample tested. The following example of the method as actually applied to the Charleston water will illustrate the procedure.

Test Procedure

A one gallon sample of filter effluent, taken ahead of plant treatment with lime, was collected in a gallon glass bottle. The pH of the sample was determined and found to be 6.5 and the total alkalinity (Methyl Orange) 18 p.p.m. About 200 c.c. of the sample was then transferred from the bottle to an Erlenmeyer flask. One teaspoon full of C.P. powdered (precipitated) $CaCO_3$ was added to the water in the flask and stirred for five minutes. The carbonate was then allowed to settle, af-

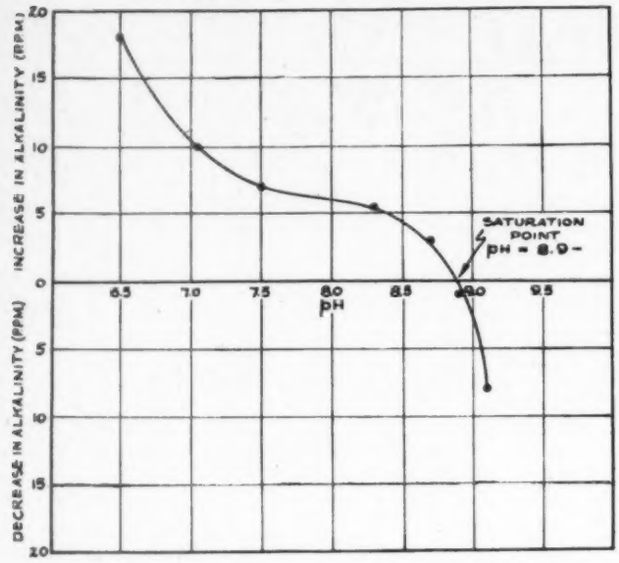


Fig. 1—Saturation Point of Charleston Filtered Water

ter which the supernatant liquid was filtered through filter paper and the alkalinity determined on the filtered portion. This alkalinity was 36 p.p.m., an increase of 18 p.p.m. over that of the original sample in the gallon bottle. The increase in alkalinity was then plotted against the original pH value (6.5), thus determining the first point on the curve. (See Fig. 1.)

Hydrated lime in solution (lime-water) was then added gradually to the original sample in the gallon bottle and thoroughly mixed by stirring until the pH of the sample had increased to approximately 7.0—in this instance, 7.05. At this pH the alkalinity was determined on an unfiltered portion and found to be 24 p.p.m. A 200 c.c. portion of the sample was transferred, as before, to an Erlenmeyer flask; $CaCO_3$ was added, mixed for 5 minutes, settled, filtered and the alkalinity of the filtrate determined. It had increased to 34 p.p.m., representing a 10 p.p.m. pick-up of alkalinity from the carbonate as compared to an 18 p.p.m. pick-up in the first test on the unlimed sample. The second point on the curve was thus located, the increase in alkalinity of 10 p.p.m. being plotted against the pH of 7.05, which was that of the lime treated test sample.

More lime was then added to the water in the gallon bottle until the pH was raised to 7.5. At this pH value the alkalinity was 25 p.p.m. As before, a portion of the sample was removed and treated with $CaCO_3$, and an increase in alkalinity of 7 p.p.m. was observed. This increase was plotted against pH 7.5, forming the third point on the curve.

In a similar manner the pH of the sample in the bottle was raised with lime to pH values of 8.3, 8.7, 8.9 and 9.1 and the differences in alkalinities after treatment with $CaCO_3$ were plotted against each of these pH values.

It will be noted from the curve that at pH 8.7 the water was only slightly undersaturated, the increase in alkalinity after treatment with $CaCO_3$ being but 3 p.p.m. At a pH of 8.9, however, the alkalinity decreased 1 p.p.m. after treatment with $CaCO_3$, showing that at this pH the water was slightly supersaturated and some calcium alkalinity had deposited out on the suspended carbonate. Therefore, the exact point of equilibrium lay between these two pH values, or for all practical purposes at pH 8.9—see Fig. 1. The pH of the sample in the bottle was then increased to 9.1 in order to portray the trend of the curve more accurately.

Having determined the saturation point of the sample by the above procedure, its adaptation to plant control consists merely in adding enough lime to the filtered water to maintain a pH value of 8.9 or thereabouts in the plant effluent.

Inasmuch as free carbon dioxide gas (CO_2) influences the solubility of calcium carbonate in water, care should be taken in carrying out the procedure not to allow the sample to come in contact with the air any more than possible, and to avoid shaking or violent agitation of the sample. Removal of portions of water from the original sample should be made with a transfer pipette and a good grade of filter paper should be used for filtering the portions treated with $CaCO_3$. The procedure is carried out at room temperature and it is believed that a negligible error may be introduced thereby, since in the case illustrated the temperature in the Charleston laboratory was some 10 to 15 degrees higher than the temperature of the water in the clear well and in the mains.

A convenient and explanatory method of recording the data obtained in carrying out the procedure is shown below:

Filter Effluent—Charleston, October 17, 1935

pH 6.5	$CaCO_3$ added, mixed		Undersaturated
Alk. 18	settled and filtered	Alk. 36	+18
Lime added:			
pH 7.05	$CaCO_3$ added,		Undersaturated
Alk. 24	etc.	Alk. 34	+10
Lime added:			
pH 7.5	$CaCO_3$ added,		Undersaturated
Alk. 25	etc.	Alk. 32	+7
Lime added:			
pH 8.3	$CaCO_3$ added,		Undersaturated
Alk. 27	etc.	Alk. 33	+6
Lime added:			
pH 8.7	$CaCO_3$ added,		Undersaturated
Alk. 28	etc.	Alk. 31	+3
Lime added:			
pH 8.9	$CaCO_3$ added,		Supersaturated
Alk. 32	etc.	Alk. 31	−1
Lime added:			
pH 9.1	$CaCO_3$ added,		Supersaturated
Alk. 35	etc.	Alk. 27	−8

The Influence of Calcium Bicarbonate in the Water to Be Treated

It is known that when the calcium carbonate content of a water is less than 25 to 35 p.p.m., the calcium car-

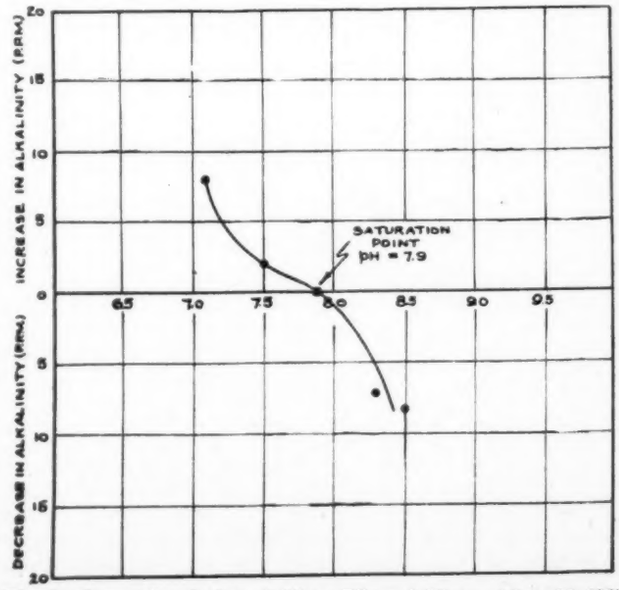


Fig. 2—Saturation Point of Nitro Filtered Water (Oct. 23, '35)

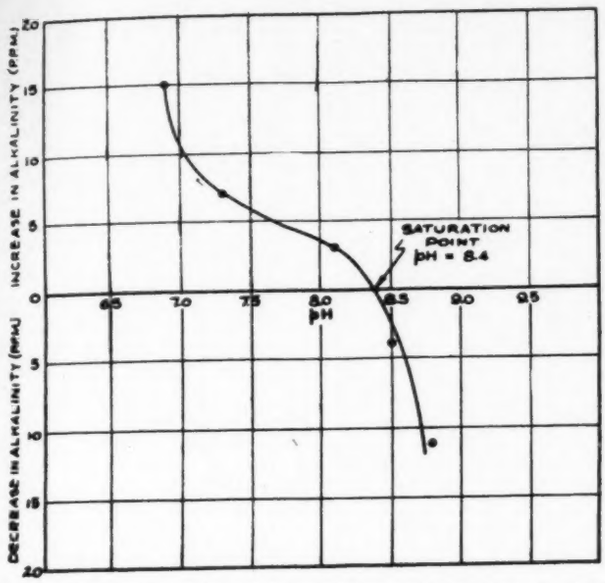


Fig. 3—Saturation Point of Nitro Filtered Water (Oct. 18, '35)

bonate content must be built up to this amount before corrosion can be effectively prevented. The alkalinity of the Charleston water used to illustrate the procedure was but 18 p.p.m., and the water was therefore below the prescribed limits as to its calcium carbonate content. However, this deficiency was automatically taken care of in the procedure and in its adaptation to plant control methods by the use of lime which increased the calcium carbonate content to the point required for saturation. Several of the water supplies requiring corrective treatment operated by the West Virginia Water Service Co. normally, or occasionally, have calcium carbonate contents in excess of the minimum requirements. The procedure for determining the pH of the saturation point for these waters is carried out with lime in the same manner as described for the Charleston water.

Figure 2 shows the curve obtained by the procedure on such a water. The sample was taken recently from the filter effluent of the Nitro plant which treats Kanawha River water and had a pH of 7.1 and an alkalinity of 47 p.p.m.

The saturation point of the same supply, determined five days previously, is shown by Fig. 3. In this case, the pH of the filter effluent before lime addition was 6.9 and the alkalinity was only 39 p.p.m. The stream in question is subject to heavy contamination by industrial wastes but a freshet would bring about a like condition.

As stated previously in this paper the streams in West Virginia requiring treatment for the prevention of red-water and corrosion are "flashy" and the dissolved mineral constituents of these waters change materially—frequently, in the space of a few hours. At the Charleston plant, for example, during a period of high water conditions experienced in the Elk River in August of this year, the alkalinity of the raw water decreased gradually from 24 to 12 p.p.m. and the hardness decreased correspondingly. Similar increases in alkalinity and in hardness are usually observed during periods of dry weather. Inasmuch as the pH of the saturation equilibrium with calcium carbonate of any water depends, among other factors, upon the concentration of dissolved alkaline compounds in that water, it has been found, as would be expected, that the pH of the saturation point varies with changes in the chemical composition of the water. As the alkalinity decreases, the pH and total alkalinity at the saturation point increases and vice versa.

Protective carbonate coatings will be quickly dissolved and removed if the water in contact with them is undersaturated. Also, such coatings will be built up too rapidly if the pH of the water is carried too high above the saturation point. Therefore, to practice effective control in the treatment for the prevention of red-water and corrosion on a supply of fluctuating chemical character it is necessary to vary the pH of the plant effluent as frequently as is required to meet changing raw water conditions.

A General Curve for Plant Control

For a given supply, saturation points (pH values) can be determined by the procedure for various alkalinity values and a saturation curve plotted from this data. Figure 4 represents such a curve under process of development for the Charleston water. With experience the number of trial tests can be reduced, and once the curve has been established for a supply, the approximate pH of the plant effluent of that supply required to bring the water to equilibrium with calcium carbonate can be selected at once by merely determining the total alkalinity of the water to be treated. Then, if desired, a single check test should confirm this value if made on the plant treated water. With the aid of such a curve the plant operator can, and should, vary the pH of his plant effluent daily or more frequently if required.

When corrective treatment is first applied to a water supply it is probably best to deliver the water to the distribution system in a slightly supersaturated condition for a period of several months or until a thin protective film has been built up in the mains. The treatment should then be reduced and maintained as closely as possible at the pH of the saturation point with calcium carbonate. It will be found difficult, if not impossible, to maintain the pH at exactly the desired value under ordinary methods of plant control but the slight variations experienced should not impair the success of the treatment in so far as overall practical results are concerned.

In closing, it should be pointed out that the procedure presented in this paper is not held to be without errors but it is believed that the procedure provides a rapid and workable method, sufficiently accurate for the purposes required, whereby the pH of the saturation point of a water can be obtained from a single sample of that water, thereby eliminating cut and try methods on a plant scale. At least it has been successfully applied to the low alkalinity waters encountered in several West Virginia plants.

Acknowledgment.—The above paper was presented before the West Virginia Conference on Water Purification, October 31, 1935, at Charleston, W. Va.

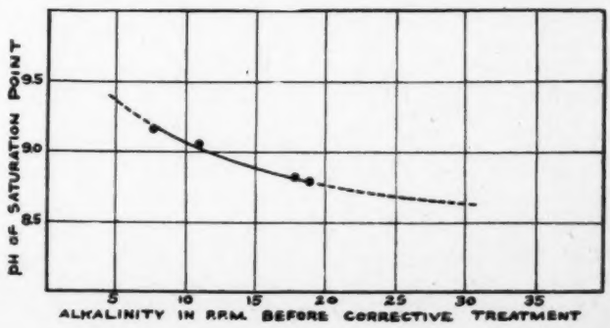


Fig. 4—

On to California!

TO date replies to cards sent out by A. W. W. A. to members east of the Mississippi River indicate that 130 are definitely planning to go out to the Los Angeles Convention, June 8th-12th. And, the list is growing. The "Water Works Special" to California proved so successful in 1928, when the convention was held in San Francisco, that a 1936 "Water Works Special" will be run to Los Angeles—leaving New York in the late afternoon, May 29, and arrive in Los Angeles, June 7.

John S. Warde, Chairman of Transportation Committee for A. W. W. A., who did such a good job of arranging the tour in 1928, has been "re-elected" to handle the "1936 Special." The schedule laid out includes stop-overs at Colorado Springs, Salt Lake City, Bryce Canyon National Park, and Boulder Dam. From Colorado Springs the Denver and Rio Grande Railway Scenic Route, which passes through the famous Royal Gorge and crosses the Rockies at the highest elevation taken by any trans-continental line, was chosen as the most scenic route to the Pacific Coast. Returning, the "Special" will stop over at San Francisco and Vancouver, B. C., thence through the awe inspiring Canadian Rockies to stop over at Lake Louise and Banff.

This trip will cost (all expenses, rail and Pullman fares, and side trips) roughly $350.00 as against $500.00 for the 1928 trip. With the recent reduction in rail and Pullman rates ordered by the Interstate Commerce Commission, the $350.00 rate will likely be reduced accordingly. The round trip rate with Pullman out and back on regular trains is less than $200.00 for those who may not be able to travel on the "Water Works Special" and "see the country" in both directions with a congenial group of the Water Works Fraternity.

Many of those who traveled out together on the 1928 "Water Works Special" are planning to make the trip on the "1936 Special" a reunion affair.

To date (March 5th) those listed below have signified their intention of going out to the Los Angeles Convention and the list continues to grow daily. Watch it grow in the next (April) issue. If you plan to go, send in your name to John S. Warde, Chairman, A. W. W. A. Transportation Committee, 50 Church St. New York City, or to WATER WORKS AND SEWERAGE.

THOSE KNOWN TO BE PLANNING TO ATTEND THE LOS ANGELES CONVENTION*

(Returns received up to March 5th)

G. D. Alvoid, Pittsburgh, Pa.
P. B. Andrews, Rome, N. Y.
John L. W. Birkinbune, Philadelphia, Pa.
M. M. Brardech, Cleveland, O.
D. G. Beach, Pittsburgh, Pa.
Chas. H. Becker, Philadelphia, Pa.
H. K. Bell, Lexington, Ky.
James R. Brown, Columbus, Ohio
L. G. Braelford, South Bend, Ind.
Louis D. Blum, New York City, N. Y.
Harry Boggs, Indianapolis, Ind.
W. W. Brush, New York City, N. Y.
J. S. Besterman, Sewickley, Pa.
A. M. Bowman, Ontario, Canada.
Frank A. Barbour, Boston, Mass.
R. W. Bates, Buffalo, N. Y.
A. E. Berry, Toronto, Canada
C. K. Calvert, Indianapolis, Ind.
W. P. Cox, Birmingham, Ala.
E. F. Case, New York City, N. Y.
G. A. Corine, Superior, Wisc.
H. T. Critchlow, Trenton, N. J.
Lewis V. Carpenter, Bronx, N. Y.
W. R. Concord, Burlington, N. J.
Chas. R. Cox, Albany, N. Y.
R. C. Clement, Washington, D. C.
W. G. Classon, Leominster, Mass.
Joel I. Connolly, Chicago, Ill.
E. F. Dugger, Newport News, Va.
D. E. Davis, Pittsburgh, Pa.
W. A. Dallach, Chicago, Ill.
Clinton Decker, Birmingham, Ala.
Linn H. Enslow, New York City.
J. B. Eddy, Chicago, Ill.
Gail P. Edwards, Cambridge, Mass.
W. M. Franklin, Durham, N. C.
Daniel Fahlstrom, Putnam, Conn.
George H. Felix, Reading, Pa.
Kyle Forrest, Mineola, N. Y.
J. W. Fleet, Brooklyn, N. Y.
John M. Gilfillan, Birmingham, Ala.
George H. Gleason, Newark, N. J.
F. W. Gilcreas, Albany, N. Y.
W. R. Gelston, Quincy, Ill.
L. H. Haldred, Oneonta, N. Y.
M. L. Hough, Williamsport, Pa.
Frank E. Hale, Brooklyn, N. Y.
F. W. Hartmann, Chicago, Ill.
L. L. Hedgepeth, Philadelphia, Pa.
Joe R. Hendrickson, Birmingham, Ala.
W. A. Hardenbergh, New York City.
Norman J. Howard, Toronto, Canada.
John P. Harris, Chicago, Ill.
W. A. Helbig, New York City.
Frank C. Hopkins, Utica, N. Y.
Clinton Inglee, New York City.
H. Seaver Jones, New York City.
Chas. F. Jost, New York City.
W. N. Jones, Tampa, Fla.
E. A. M. Johnson, Pittsburgh, Pa.
Harry Jordan, Indianapolis, Ind.
John A. Kienle, New York City.
C. R. Knowles, Chicago, Ill.
W. G. Kirchoffer, Madison, Wis.
A. P. Kuranz, Waukesha, Wis.
John W. Kay, Milford, Mass.
Harold L. Londo, Green Bay, Wis.
B. C. Little, Rochester, N. Y.
Chas. A. Leonard, Hoosick Falls, N. Y.
Chas. L. Link, Elkhart, Ind.
W. C. Lawrence, Cleveland, O.
C. A. McGinnis, New York City.
Cortland M. Mosier, Spring Valley, N. Y.
Chas. W. Mowry, Boston, Mass.
E. F. Muser, Chester, Pa.
Owen A. McCarthy, Dearborn, Mich.
H. H. Morrison, Chattanooga, Tenn.
Karl M. Mann, New York City.
Earl A. Munyan, Cincinnati, Ohio.
H. L. Meites, Chicago, Ill.
Guy C. Northrup, New York City.
B. V. E. Nordberg, Milwaukee, Wis.
H. D. Nelson, Pittsburgh, Pa.
C. S. Patton, New York City.
Howard J. Pardee, Long Island City, N. Y.
Sheppard T. Powell, Baltimore, Md.
W. W. Polk, Evanston, Ill.
L. A. Quayle, Cleveland, Ohio.
A. V. Ruggles, North Tarrytown, N. Y.
Abel Reynolds, Providence, R. I.
Frank C. Roe, Niagara Falls, N. Y.
W. H. Roth, Philadelphia, Pa.
Harold Sandbach, Cary, Ind.
M. J. Shoemaker & Son, Madison, Wis.
J. S. Strohmeyer, Baltimore, Md.
George O. Schaut, Philadelphia, Pa.
Marion Stewart, Natchez, Miss.
Leon A. Smith, Madison, Wis.
J. D. Stosiak, South Moline, Wis.
Fred E. Stuart, New York City.
Earle Talbot, Weehawken, N. J.
H. R. Welsford, Philadelphia, Pa.
T. F. Wolfe, Chicago, Ill.
L. F. Warrick, Madison, Wis.
Abel Wolman, Baltimore, Md.
Theo. D. Wood, Philadelphia, Pa.
John S. Warde, New York City.
W. M. Wallace, Detroit, Mich.
Howard T. Ware, Endicott, N. Y.
J. S. Watkins, Lexington, Ky.
C. H. Young, Meadville, Pa.
R. G. Yaxley, Waterford, N. Y.

*Note—Many of the above have indicated that they will be accompanied by their wives or other members of their families.

WHY WATER WORKS SUPERINTENDENTS LIE AWAKE NIGHTS

Featured on N. E. W. W. A. Program

THE attendance at the February meeting of the New England Water Works Association, held in Boston on February 20th, was evidence enough that it takes more than sub zero weather to keep New England water-works men away from their lively Winter Meetings.

A novel feature of the meeting was the "Round Robin" arranged by President Roger Esty, in which seven superintendents were invited to sit at the speaker's table and then made to tell "Why Water Superintendents Lie Awake Nights"; also, to confess those "Good Ideas That Didn't Work." The high-light of this part of the program was the story of "Pat" Gear, Water Supt. at Holyoke, Mass., who told of "How a Tin-Can Discovered a Leak" and how one "Good Idea

"Self-Starter" Getchell (Bristol Water Co.) Got Cold Weather Problem Well "Thawed-out" in Super's Round Table

Patrick Gear, Holyoke's Superintendent. "Shoot Him, Egan—And, Egan Did!"

That Didn't Work" caused a general clean-up of the town.

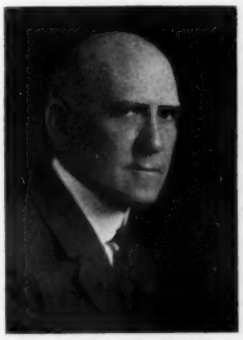
Here's Pat's "Confession"—A little innocent skunk out on a leaf catcher rack near the Holyoke intake. Egan wanted to know how to get "the little fellow" away—without damage to Egan. Pat said, "Shoot him, Egan"—and, Egan did! Well, said Pat, that was surely "A Good Idea That Didn't Work," because the telephone began to ring pretty soon after and not many people in town enjoyed their coffee that day. Two million gallons of water had to be wasted through blow-offs. Knowing the odor, but never before having had it served in drinking water, a great many unsuspecting people cleaned out their cellars that day, looking for the "little fellow." The net result was a general town clean-up of cellars—all because of an idea that didn't work.

Other "brother-confessors" were — Superintendent Harold L. Brigham of Marlborough, Mass., who told of unsuccessful leak (split) patching with a brazing material and likewise with a joint compound; Walter B. Bushway of Brookline, Mass., who told of two supply mains left suspended in thin air, by fire burning out wooden supports, which resulted in 8 and 4 inch deflections (sag) without leaking, and told also of the subsequent lowering of the two compound jointed mains without a break or leaks developing. Then came Horace J. Cook of Auburn, Me., who told of sleepless 30 to 40 degrees below nights with mains 5 ft. in the ground freezing up in 1934; and, also, of the unsuccessful attempts to collect $35,000 in unpaid bills by persuasive telephone calls and, thereafter, appealing letters to the customers. As a last resort the old time-tested method of shutting off water proved "the" good "idea" that did work. George F. Merrill of Ware, Mass., told of sleepless nights locating a leak which had emptied the system; Samuel E. Killam of Boston told of the 4 foot lowering of a 20 inch concrete encased inverted-syphon across the bay; and, Geo. E. Hawkins of Brattleboro, Vt., described a major supply line in a precarious location. That was his "ghost" in the night.

Pension Legislation

Of exceptional interest to municipal employees, was the analysis of House Bill 1501, now before the Massachusetts Legislature. This bill will establish pension systems which will benefit water works managers and operators, and other municipal officials and employees.

James J. Fitzgerald, Chairman of the Springfield, Mass, Committee on Pensions, explained that the bill, if passed, would provide a combination (50/50) annuity and pension. The annuity fund was to be compounded by drawing out 5 per cent from the salaries and wages of municipal employees. In turn, the municipality would simultaneously put up an equal amount to be deposited to the employees' credit in the pension fund. At 60 years of age the employee would have the right to retire and draw the accumulated plus accrued benefits; or, if found fit, he could work until 70 when retirement would become mandatory. It would be possible for faithful employees to draw an annuity-pension approximating 50 per cent of their average pay during the closing 5 years of service. After 20 years of service, retirement



Stephen H. Taylor, New Bedford's Supt., Has Blazed a Trail in Regulating of Private Water Piping and Plumbing

Horace J. Cook, Supt., Auburn, Me., Water Distr., Found Frost-Jackets "Gave a Mite More Bother" But Saved Hydrants at 40 Below

on account of disability was allowed. After 30 years of service it would be possible to retire, with pay at the rate of $2,500 per year, provided the salary averaged $5,000 during the 5 years previous. The new law, said Mr. Fitzgerald, would not make adoption of the plan

Geo. E. Hawkins, Supt., Brattleboro, Vt.; Percy A. Shaw, Supt., Manchester, N. H.; Harold L. Brigham, Supt., Marlborough, Mass.

by all Massachusetts cities mandatory and, therefore, a vote of acceptance by individual municipalities would be required. In cities and towns adopting the law the older employees would benefit to the extent that the municipality would credit the employee with the full allowance (10 per cent of his yearly earnings) covering the period of service prior to the initiation of the 5 per cent annuity deductions. Such credits would show on the pension side of the ledger and be subject to pension regulations.

In the ensuing discussion a member asked "What happens to the employee who suffers from a too well known "disability," inherent with political changes in local administrations?" There seemed to be no clause in the proposed law which would prevent such a happening, and the "disabled" one would receive merely his share of accrued savings (annuity) along with his walking papers. (All of which constitutes additional evidence that for Water Works and Sewerage operators some form of Licensing Act seems highly desirable (in Massachusetts as elsewhere) to protect technical men against suffering a "political disability." And, with such, a loss of equity in pension funds.—*Editor.*)

A Water Department That Regulates Piping Within Buildings

The Water Board of New Bedford, Mass., and the Superintendent of Water, have taken the stand that complaints of customers are so prevalently traceable to the installation of pipes which are both undersized and of materials which are easily attacked by the water to create rusty water, chokage of lines, leaks, etc., that the Water Department, to avoid reflection on it, should have a voice in the design and selection of materials for the interior piping of buildings. Further, that cross connections, and many types of sanitary fixtures constitute a hazard, until recently little appreciated, which should be prevented by the Water Department in its own interest as well as that of the public.

With this in mind, Stephen H. Taylor, Superintendent of Water, at New Bedford, Mass., told of "The Regulation of Water Piping in Buildings"* which had been put into force on June 1st, 1935, by the New Bedford Water Department. To prosecute such regulations a master-plumber had been employed by the Water Department and all master-plumbers had been required to register with the Water Department. Since June 1st 700 permits had been issued for new work and corrections of existing plumbing to preclude possible back-syphonage from toilets, etc., in public buildings had been required. Mr. Taylor pointed out that the City Solicitor had ruled that such regulatory procedure properly belonged under the Water Department.

In reply to a question concerning the possible legal responsibility of the Water Department, Mr. Taylor felt that there would be a definite moral responsibility but no legal responsibility.

Superintendent Merril (Ware, Mass.) suggested that large buildings, mills and factories should be required to paint all water piping a distinctive color to facilitate inspection by water-works officials or employees, or other authorities.

SUPERINTENDENT PERCY SHAW (Manchester, N. H.) reported that preliminary inspections of buildings in Manchester to locate hazards from plumbing cross connections warranted a more careful survey which was planned. He called attention to the recent bulletin of the Wisconsin Department of Health on plumbing hazards which had proved very enlightening and helpful in the Manchester surveys.

COMMISSIONER RICHARD ELLIS (Newton, Mass.) feeling that, although it seemed highly desirable to have piping in buildings approved by the water department, one could not overlook the question of usurping the prerogatives of existing building and plumbing inspection departments in many cities.

WARREN J. SCOTT, Chief Engr., Connecticut Department of Health, felt that water departments by cooperative efforts were in a position to guide the city plumbing inspector, even though actual routine regulation might not be a specific function of the water department.

"B. Coli—What Are They and What Do They Signify" was the topic dealt with by DR. GAIL P. EDWARDS, Laboratory Coordinator of the Mass. Dept. of Health. He outlined the sources of b. coli in water supplies, laboratory methods for their identification and their significance in conjunction with chemical analysis and sanitary surveys. His talk was illustrated with slides to show the most common ways in which pollution had entered deep wells of public water supplies to create water borne epidemics of consequence. He also pictured the potential sources of pollution of reservoirs used for recreational purposes. Dr. Edwards' slides told their "stories without words" so effectively that several bids for the loan of them were made. It was evident thereby that recreational use of reservoirs in New England is the bugaboo of water works superintendents—a threat that has recurrently to be fought off. [Quite a contrast with conditions in other sections where water supply bonds are voted on the strength of creating, therewith, local recreational facilities involving the use of marginal area if not also regulated, and supervised usage of the reservoir proper.—*Ed.*]

Stream Pollution Resolution Passed

Paralleling the actions taken by the Board of Directors of the American Water Works Association and the American Society of Civil Engineers in January, per-

Walter B. Bushway, Supterintendent, Brookline, Mass.; Gail P. Edwards, Mass. Dept. Health, Boston, Mass.; Geo. F. Merrill, Superintendent, Ware, Mass.

*(Elsewhere in this issue, Mr. Taylor's paper is printed in full because of the importance which the New Bedford development may assume in placing plumbing inspection under water departments and building inspection departments jointly, if not wholly under the water department.—*Ed.*)

Arthur D. Weston, Chief Engineer, Mass. Dept. Health, Offered a Resolution Against Having New Dealers in Control of Streams

John Warde, A. W. W. A.'s Transportation Expert, Came to Drum Up Business for "Water Works Special" to California Convention

taining to the assumption of authority by the Federal Government in the matter of stream pollution control, Arthur D. Weston offered a resolution directed against S-Bills 3958 and 3959 (drawn by U. S. Senator Lonergan of Connecticut) which are to be presented to the Congress. The Weston resolution stated, in effect, that N. E. W. W. A. wished to put itself on record as being opposed to any legislation placing stream pollution under federal control; and, that congressional representatives from the New England States be so advised. Further, that in the future all federal agencies charged in the future with stream pollution matters be limited to fact finding only and that cooperation with state and municipal authorities be available upon request. After some discussion the resolution was put to vote and carried with a single "No" recorded against it.

On to California!

At this point, President Esty called on John Warde, who will have charge of the "Water Works Special" from the East to the A. W. W. A. Convention in Los Angeles and return, to tell of the plans for the trip. Mr. Warde outlined the tour selected which will start from New York on May 29th and take in Colorado Springs, the Royal Gorge, Salt Lake City, Bryce Canyon and Boulder Dam enroute to Los Angeles for the convention June 8th-12th. Returning, the route would be to San Francisco, Vancouver, B. C., and back through the Canadian Rockies with stops at two picture spots—Lake Louise and Banff.

Asked concerning the transportation rates, Mr. Warde said that the tour, including all transportation (side trips also) with lower Pullman berth, would cost only $350.00. The fare and Pullman direct to Los Angeles and back would be only $172.00 from New York City. [In our next, if not in this issue, will be found a list of those who have already signified their intent of going to the Californa convention. This list is growing rapidly in length.—Ed.]

Superintendents' Round Table

(Cecil G. Getchell presiding.)

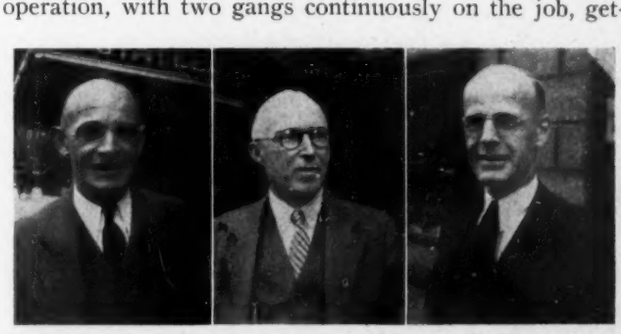
In the forenoon the Superintendents' Round Table was held under the leadership of C. G. Getchell, Manager of the Bristol County Water Company, Bristol, R. I. Appropriately enough, the general topic was that of:

"Cold Weather Problems"

Concerning Frost Jackets—Concerning the value of frost jackets around fire hydrants, there was a divergence of opinion expressed. Mr. Getchell had had 5 hydrants to break off at the lead-in from the main and 3 of these had frost jackets. He questioned their value. MR. BRIGHAM (Marlborough, Mass.) said they had discontinued frost jackets. MR. HEFFERNAN (Milton, Mass.) never used jackets; never had a break due to frost lift because he packs around the barrels crushed stone to preclude the earth-frost lift. MR. COOK (Auburn, Me.) favored the jackets which apparently had stopped breakage at the lead-in branch, even when there was a 48 inch frost depth. The jackets, being shoved above ground by the frost, "gave a mite more bother" in having to be driven back down in the Spring—but, said Mr. Cook, that showed them to be doing the job that they were there for. MR. TAYLOR (Ludlow Valve Co.), being asked for an expression, replied that frost jackets had little value in gravelly or sand soil but in heavy soil (clays) had served their purpose of preventing frost-lift strains, especially so on hydrants with flanges or beading around the barrel.

Winter Inspection of Hydrants—Concerning hydrant inspection, Mr. Cook (Auburn, Me.) said that during winter every hydrant received a weekly inspection. Drip holes were plugged but no anti-freeze was used in the barrels. The annual cost was $5.00 per hydrant, charged to maintenance.

It was reported that the Fire Department in Portland, Me., was responsible for hydrant maintenance there. MR. BOARDMAN (Danvers, Mass.) reported that leaky hydrants were followed up with frequent inspections during winter, alcohol being used in these as anti-freeze. MR. CALDERWOOD (Nashua, N. H.) had found that inspecting for water in the barrel was not always sufficient. In making the open valve wet-test he had sometimes found just enough ice under the valve to prevent its opening. A little hot water poured in loosened the ice sufficiently to make opening easy. MR. BRIGHAM (Marlborough, Mass.) said that they used the compact Ross thawing equipment for the same purpose. It was quick to generate steam and very successful. MR. BOARDMAN (Danvers, Mass.) said that each fire truck carried one of these Ross thawing units. MR. ENSLOW (WATER WORKS AND SEWERAGE) reported that concentrated sulphuric acid poured into lightly frozen hydrants would immediately produce sufficient heat to loosen the ice. The scheme was one used in the South at times, small bottles of the acid being carried on the fire truck also. To a question, he replied that dry (concentrated) sulphuric would not attack metals; further, that the acid would not be in the hydrant long enough to damage it before the rush of water cleared it out completely. MR. PAT GEAR, who explained that he was from Holyoke, Mass., where the Water Works were "Municipally Owned but Privately Run," reported hydrant inspection was with them a 365 day per year operation, with two gangs continuously on the job, get-



Nelson Boardman, Asst. Supt., Danvers, Mass.; Dave Heffernan, Supt., Milton, Mass.; John H. Read, Asst. Supt., Manchester, N. H.

ting around to each hydrant about every two weeks. They collected $16.00 annual rental per hydrant but paid taxes as a corporation, which recently amounted to $18,500—i.e., 10 per cent on a net income of $185,000. MR. HEFFERNAN (Milton, Mass.) startled fellow superintendents by confiding that he was getting $35.00 rental on each of 700 hydrants and was asking for $55.00. Why? To avoid raising meter rates (already 25 cents per 100 cu. ft.) for water purchased at wholesale from the Metropolitan Water District of Boston and retailed to Miltonians. [If this isn't a record hydrant rental (actually collected) by a Municipal Water Department, WATER WORKS AND SEWERAGE will publish a bigger and better story—let's have it.—Ed.]

Thawing Services—The question of "how long does it take to thaw a service by electricity" was put to Mr. Hawkins (Brattleboro, Vt.) who reported that copper and lead services had been thawed with a Hobart generator set in 3 to 5 minutes with 400 amps. at 20 volts; whereas steel or iron services required but 200 amps. at 40 volts for effect in 3 to 5 minutes. Thawing of cement-lined services (up to 2 inches) had given no difficulty except that a longer time had been required due to the insulating effect of the cement lining, which was not damaged, however, by the operation. MR. CALDERWOOD (Nashua, N. H.) pointed to the fact that every time the amperage flowing on the thawing circuit was doubled the heating value of the current increased four-fold. MR. GETCHELL (Bristol, R. I.) told of freak experience where a thawing operation had fused together touching gas and water pipes, thereby causing some embarrassment to the water utility when gas stoves in the vicinity turned into bubbling fountains.

And so to luncheon and the afternoon session, reported here in reverse, where Bristol's "Self-Starter" Getchell took a bow for his morning's accomplishments in getting Cold Weather Problems "thawed out" to a point where it was tough to have to "shut-off" the flow.

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6,000,000 Gal. Elevated Storage for Buffalo, N. Y.

The accompanying illustration is a picture of the first 2,000,000 gallon capacity elevated tank just completed for the Water Department of Buffalo, N. Y.; Alan D. Drake, Director. Two others of the same design, dimensions and capacity are being installed at strategic locations on the distribution system to complete the Buffalo project which involves elevated storage of 6,000,000 gallons.

First 2,000,000 Gallon Elevated Tank Just Completed at Buffalo

These units which are being supplied by the Chicago Bridge & Iron Works are of the unique radial-cone design. Like giant mushrooms they have a diameter spread of 122 feet but are only 25 feet deep (maximum water level to minimum), thereby limiting head variations. The smallish looking "stem" of the "mushroom," which in reality measures up to a fair-sized California red-wood tree, is the 10 foot diameter riser, which measures 84 feet from ground level to the radial-cone tank bottom. One of the other tanks will stand 125 feet above ground level and the third 95 feet. Otherwise they are identical.

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Paterson Engineering Company Disclaims Responsibility for Singapore Filter Design

In the article "Water Supply and Sewage Disposal at Singapore, S. S." by I. W. Mendelsohn, in the November, 1935, issue of WATER WORKS AND SEWERAGE the following statement appears on page 371: "When the filtration plant was built, according to the design of the Paterson Filter Company of England, no provision was made for a coagulation basin, a mixing chamber or aerator for the iron impregnated water."

From O. C. Kerrison, Director, Paterson Engineering Company of London, England, comes a letter of explanation from which we quote, in part, to dispel whatever false impression the above statement of fact may have created in respect to the technical ability of the Paterson Company. Quoting from Mr. Kerrison's letter: "Undoubtedly the author was unaware that at the time this plant was designed the Pontian Kechil dam was not constructed and no samples of the actual water to be dealt with were available. The Water Authorities had for over two years conducted tests with an experimental filter unit dealing with river water which contained no appreciable trace of iron. On the data thus available the Consulting Engineers issued their enquiry for a rapid filtration plant using aluminum sulphate as a coagulant and lime for the correction of acidity, and the plant we supplied was so equipped. When the dam was completed it was found that the water contained considerable quantities of iron, and we suggested that aeration and sedimentation tanks should be added to the filtration installation to permit of the iron being precipitated. This was done and proved a complete remedy to the trouble which had been experienced."

[We are pleased to devote the above space to Mr. Kerrison's explanation in order that the complete story may be recorded and that any possible reflection upon the Paterson Engineering Company, as the result of publication of the bare statement of facts given the author (I. W. Mendelsohn) while visiting the Singapore plant, may be dispelled.—Editor.]

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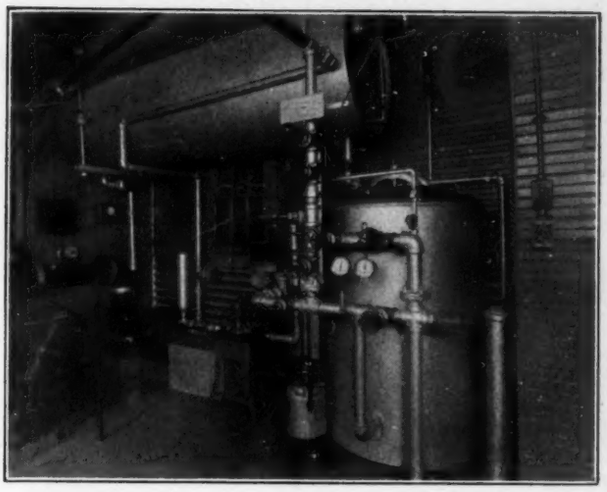
Toledo Water Works Source of City Funds

Profits from the Water Department of Toledo, Ohio, have been an important source of support of other city departments during the past five years. Such was revealed in a City Survey conducted recently in Toledo.

Prior to 1934, when its funds were segregated, the Toledo Water Department had paid $790,000 into the city treasury for the operation of other departments. At present the department has $235,000 cash on hand.



Drinking Water Plant of M. K. T. Ry. at Franklin, Mo.—Water Softener.

PRE-TREATMENT WITH IRON SALT SOLVES CLARIFICATION PROBLEM

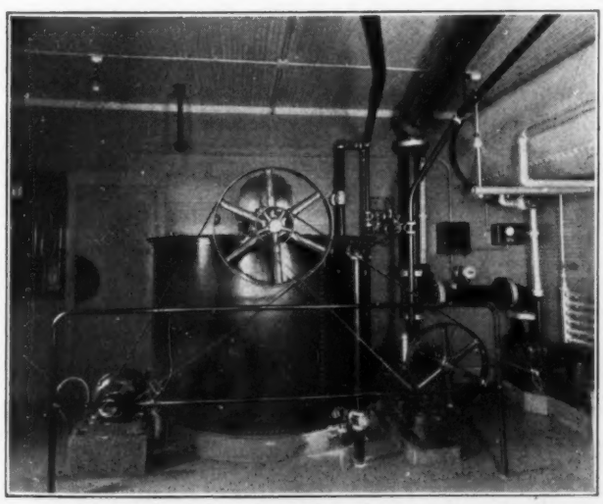
By E. L. E. ZAHM*

The Author

AS PART of the general water softening program and particularly to forestall pitting and corrosion of flues in locomotive boilers that was becoming prevalent on the St. Louis Division of the Missouri - Kansas - Texas Lines, a 30,000 gallon per hour water softener of the continuous lime-soda ash type was erected at Franklin, Missouri, in 1931.

Water for locomotive use at this terminal is secured from a reservoir. At the time the plant was built the water had a hardness of from 5.0 to 7.5 grains per gallon, with about 20.0 grains of suspended matter. However, very heavy rains during the past year caused a lowering of the hardness by about 3.0 grains per gallon but the suspended matter increased to about 40.0 grains, a great part of which was colloidal. Previous to the erection of the water softener laboratory jar tests indicated the water could be clarified as well as softened to approximately 1.2 grains by using lime and soda ash with the later addition of dry pulverized sodium aluminate. Therefore the plant equipment included the usual arrangements for handling the lime-soda ash mixture and also a separate feeding device for the coagulent. The results indicated by the jar tests were obtained in actual plant practice for several years. However when the quality of the reservoir water changed and the colloidal condition was encountered it was found impossible to properly clarify and soften the water despite the fact that almost 14 hours settling time was available. If sufficient soda ash was used to obtain a low residual hardness, coagulation was poor and the effluent from the softener turbid. A series of experiments was conducted in order to overcome these difficulties.

*Water Inspector, M.K.T. (Ry.) Lines, Parsons, Kan.

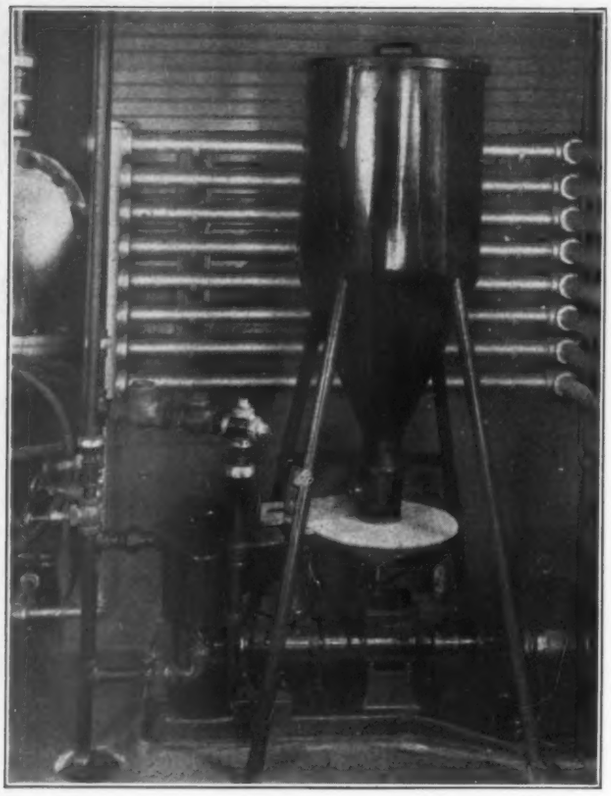


Chemical Vat and Pump, Softening Plant of M. K. T. Ry., at Franklin, Mo.

The mixing cone in the top of the downtake was first baffled to allow a better mix between the chemicals and the raw water. The sludge line was tapped to afford a small connection to the chemical pump intake in order to utilize the precipitate in the water at the bottom of the softening tank as a means of starting the floc in the raw water. These measures were, however, of little benefit.

Since the sodium aluminate was discharging near the outer edge of the mixing cone after the raw water had had a short mix with the lime and soda ash it was decided to prolong the period by running the "sodium aluminate discharge line into the downtake about 40 feet in order to allow a more thorough mix before the aluminate was added. This was done and the coagulent was added at various levels by lengthening or shortening the 1-inch pipe. Results were not improved.

Mixing and feeding of the lime and sodium aluminate together and the addition later of the soda ash in the downtake by means of the dry feed machine produced



Dry Feed Machine Now Used to Feed Iron Sulphate, Franklin, Mo.

results that were somewhat better. The soda ash, however, was not handled very well by the particular feeding device and although a water only slightly turbid was obtained at times, the residual hardness was not satisfactory.

The Successful Remedy

Finally, the lime, soda ash and sodium aluminate were mixed together and iron sulphate was fed through the dry feed machine, the iron salt being added to the raw water about one minute *before* the other chemicals were introduced. This treatment gave instant results and after slight adjustments in the chemical dosages the effluent was perfectly clear and contained less than 0.5 grain per gallon of total hardness. This method of handling has been continued with entirely satisfactory results as indicated in the table below.

Treated Water				*Raw Water*					*Chemical Dosage* (*Pounds Per* 1,000 *Gallons*)
*H.**	*M.*	*P.*	*Appearance*	*H.*	*Mg.*	*M.*	*P.*	*Appearance*	
3.0	7.7	4.0	Turbid	3.0	1.5	1.5	0.0	Muddy	(Lime .66, Soda .73) S. Alm. .24
2.2	6.9	4.1	Turbid	3.0	1.0	1.0	0.0	Muddy	(Lime .66, S. Alm. .24) Soda .60
1.0	4.6	2.5	Clear	3.7	1.0	3.1	0.0	Muddy	(Lime 1.2, Soda .78, Alm. .20) Iron .64
0.7	5.5	3.2	Clear	3.7	1.5	3.3	0.0	Muddy	(Lime 1.08, Soda .78, Alm. .20) Iron .50
0.4	4.6	2.5	Clear	3.7	1.5	3.1	0.0	Muddy	(Lime 1.00, Soda .64, Alm. .20) Iron .36

*Grains per Gallon.
H = Hardness; M = Methyl Orange Alk.; P = Phenolpthalein Alk.

Note: Chemicals mixed before application are included in brackets ().

Drinking Water Supply

Prior to the erection of the softening plant, water for drinking purposes was secured from a drilled well and also transported from a city supply about 10 miles distant. These supplies were not very satisfactory and therefore facilities to filter, chlorinate and store water from the softening plant, under pressure, were included in the plans. The drinking water plant consists of a small pressure filter with suitable alum feed for reduction of caustic-alkalinity to satisfy drinking water requirements, an automatically controlled "Chlorometer" and electrically driven pump and storage tank. All of this equipment is installed in the treating plant house and cared for by the attendant who makes daily tests for hardness and alkalinites as well as residual chlorine He also forwards samples to laboratory for weekly bacteriological examination.

When the softener failed to produce a clear water due to the unusual condition of the reservoir, washing of the drinking water filter was doubled and it was necessary to use heavier alum doses in order to clarify the water and reduce the normal carbonate alkalinity. Bacteriological tests of one hundred and forty 10 cc. portions during 7 months (incubated for 48 hours using bacto-lactose broth as media) resulted in 20 positive presumptive indications although the samples showing gas formation were as a rule negative in 24 hours and B-coli were not isolated on plating. However, it is interesting to note that since better coagulation of the treated water was secured through the use of iron sulphate only two out of fifty 10 cc. portions (4%) examined as outlined above gave positive presumptive indications, which were not confirmed. In addition the alum dosage has been greatly reduced and the washing of the pressure filter has been reduced by 50 per cent. Typical results of laboratory tests of drinking water are given in the table below.

H.	*M.*	*P.*	*Taste*	*Odor*	*Residual Chlorine*
4.0	4.0	0.6	None	None	.1 PPM
3.5	4.2	0.4	None	None	.1 PPM
(Using Lime-Soda and Aluminate Treatment.)					
1.0	4.6	0.8	None	None	.1 PPM
1.0	4.6	0.9	None	None	.1 PPM
(Using Lime-Soda Ash-Sodium Aluminate. Iron Sulphate Treated Water.)					

Chicago Well Along With Sewerage Program

The Sanitary District of Chicago has reported to the Supreme Court of the United States that with PWA assistance it has been able to comply with the Court's order to reduce diversion of water from Lake Michigan to not more than 5,000 cubic feet per second.

Construction on the world's most gigantic sewer and sewage disposal plant program has been progressing at Chicago with such steadiness that with its continuation the Sanitary District will be enabled to cuts its diversion to 1,500 second feet by December 31, 1938—the requirement imposed by the Supreme Court. To date PWA allotments to the Sanitary District have amounted to $58,813,040.00. Contracts to the extent of $26,000,000 (45% of the program) have been awarded to date and approximately $20,000,000 has been spent since the work started in January, 1934.

CLEANING MACHINERY. — Tri-Sodium Phosphate when used in the proportion of four ounces to the gallon of hot water is effective in removing grease and oils from metal parts of all descriptions. It is now commonly used in machine shops.—*Monsanto "Chemical Topics."*

The Control House, Bristol, R. I., Sewage Treatment Plant. Result of Gas Explosion Feb. 13, 1936.

GAS EXPLOSION DAMAGES BRISTOL R. I. SEWAGE WORKS

THE accompanying illustrations show the results of a gas explosion which occurred on February 13th, at the new sewage treatment plant at Bristol, R. I. Occurring near midnight, no one was present at the time.

A letter received from Mr. Walter J. Shea, Chief, Division of Purification of Waters of the R. I. Department of Public Health, contains the following information:

Equipment in use at this plant consists of bar screens with mechanical cleaning, plain settling tanks and a separate sludge digestion tank with a floating cover. The effluent from the settling tanks is chlorinated before discharge to Bristol Harbor. Gas collected from the digestion tank is piped to the control house where it is burned in a furnace providing hot water which is circulated through the digestion tank to raise the temperature of the contents. At the time of the explosion the gas was not being burned in the furnace but was being wasted to a waste gas burner outside the building. Coal was being burned in the furnace—the source of the ignition.

Chlorination Room on Ground Floor of Control House, After the Explosion. Fortunately None of the Connections Were Ruptured by the Explosion. Note the Fallen Roof and Blown Out Partition.

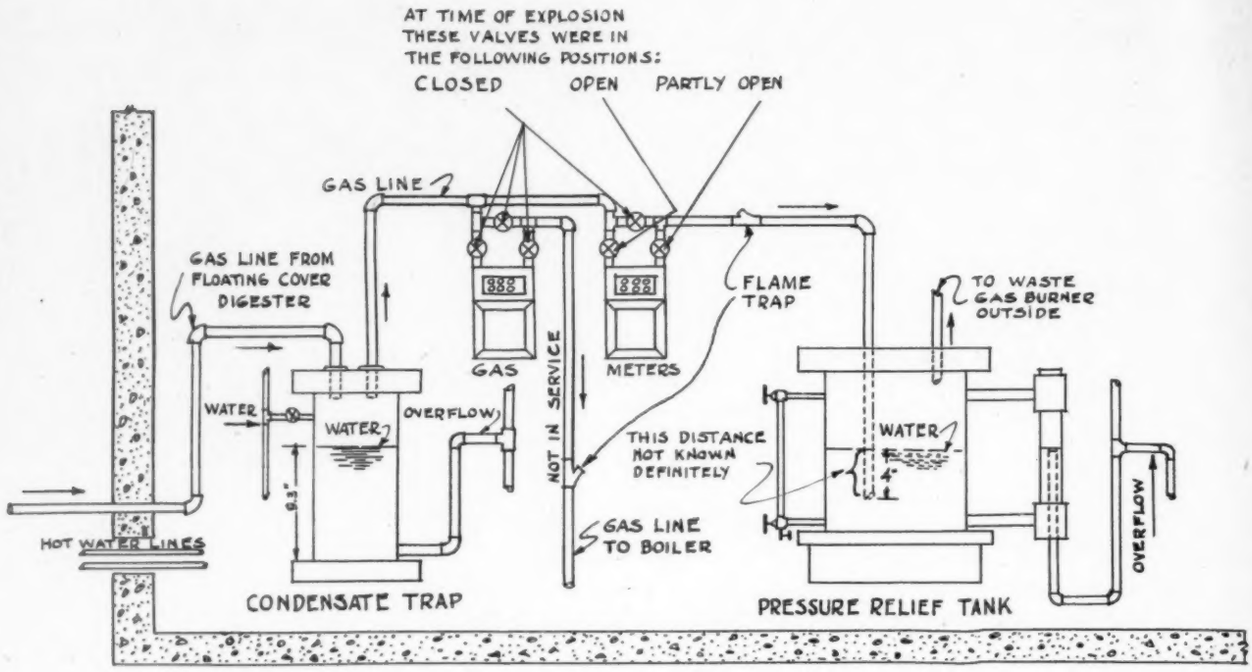
It was discovered after the explosion that a valve in the exhaust line was almost closed (see sketch). This would cause a pressure to be built up in the line between the digestion tank and this valve in the control house. There is inserted in this line a trap to catch any water carried by the gas from the digestion tank. The trap consists of a vertical cylinder in which a water level of several inches is maintained by a connection to the water supply and an overflow through an inverted elbow.

It is the consensus of opinion of investigators of the explosion that the pressure in the line, built up by closing down the valve in the waste line, forced water out of this cylinder (trap) and allowed gas to escape through the waste water outlet into the basement of the control house where the coal fire in the furnace was burning. Evidence found after the explosion indicated that in this basement the gas merely burned and that the explosion took place in the upper story on the ground level, blowing off the roof of the building, shattering a glass partition and blowing out several doors and windows. [This would be the logical sequence in view of the fact that much gas with little air burns, whereas, with decreasing ratio of gas to air the mixture becomes a detonating rather than a burning mixture.—Ed.]

While the gas burning equipment has not been constructed exactly as shown in the accompanying sketch, the general relation of the units as constructed is given.

[In reply to questions concerning the possibility that frost or ice may have formed in the gas line, and caused the blowing of the water seal, Mr. Shea replies as follows.—Ed.]:

"The waste gas line rises from the pressure relief tank to the surface of the ground and is carried along the ground outside of the building about 60 feet to the waste gas burner. The line has a slight pitch *toward*



Sketch of Gas Equipment in Basement of Control House, Bristol, R. I., Sewage Treatment Plant

the waste gas burner and a T with a plug at the burner allows draining of this line. The operator at the plant removes this plug daily to drain the line." [It would probably be more accurate to state that "the operator claimed to have removed this plug daily." Why the waste gas line should not have sloped to drain back to the pressure relief tank is not clear.—ED.]

"Concerning the question of a frost plug being formed in this waste line, it seems unlikely that such was the case because although the flame on the waste gas burner had been extinguished by the explosion, when the burner was again lighted it operated normally."

"It should be pointed out that a depth of oil of 21 inches was found at the oil seal of the gas-dome, indicating that pressure built up in the line from the digester to the meters would be released at the condensate trap which carries a depth of 9½ inches of water before the oil seal would be blown out."

Mr. Shea, in submitting the above information and illustrations for publication, at our request, states that he "Hopes this information may prove useful and serve as a warning to operators at other plants." It is on this score that we publish this article, and wish to acknowledge, with appreciation, his cooperation and contribution. The true cause for the gas leakage into the furnace room remains unanswered and there may also be an added note of warning here for designers.

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Southeastern Section A.W.W.A. to Meet in Savannah

The preliminary draft of the program for the Southeastern Section of A. W. W. A., which will hold its Annual Convention on April 7th, 8th and 9th in the metropolis of the "Deep South"—Savannah, Ga.—has been received.

Those who recall the last meeting of this Section in Savannah at the delightful Hotel DeSoto will not wish to miss the coming convention. An interesting feature of meeting will be the appearance of Dr. Chas. H. Herty, who will discuss the topic of "Water Supply in Paper Making." In connection with this, will be a visit to Dr. Herty's experimental and demonstration plant in Savannah, which is producing white paper from the lowly Southern scrub or slash-pine. Also, the large mill now under construction will be visited.

Amongst the topics on the program are the following:

Jas. E. Gibson of Charleston, S. C., will discuss "Business Administration" in the management of water works, and J. I. Connolly of the Chicago Department of Health will present an illustrated lecture on "Plumbing and Disease Hazards" which deals with dangers to water supply from back-syphonage from sanitary fixtures. Edw. S. Hopkins of Baltimore, Md., and A. J. Smalshaf of Columbus, Ga., will discuss "Coagulation and Corrective Treatment for Corrosive Waters"; N. M. De Jarnette (Ga. Dept. of Health) takes up the matter of "Laboratory Equipment Needed for Water and Sewage Plants"; M. T. Singleton and G. R. Frith (Atlanta), reporting on "Sewage Treatment Selected from Atlanta," will disclose results of experimental studies and stream surveys upon which the selections were based.

The convention closes with a golf turnament at the Savannah Country Club.

On March 31st, April 1st and 2nd, the Florida Section will hold its annual meeting at Tampa, and promises something extra in the way of celebrating its 10th Anniversary.

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A.W.W.A. Index Still on Sale

The "Index to the Journal of the American Water Works Association" which has been prepared to cover 53 years of Proceedings and the Journal is still on sale.

This index was prepared by the Association as a ready subject reference to the many articles which may be found in the Proceedings or the Journal during the period 1881-1933, inclusive.

To members of the association the price is $1.50, to others the price is $2.50, and it may be ordered through this magazine or direct from A. W. W. A. at 29 West 39th Street, New York City.

THINGS TO CONSIDER IN SELECTING SEWAGE PUMPS

By VICTOR J. MILL
*President and Chief Engineer**
Lawrence Machine and Pump Corp., Lawrence, Mass.

ALTHOUGH the pump is admittedly the heart of any sewage pumping station, it seldom is given the consideration it deserves by those charged with the design and construction of the plant. That this is the case is probably due to the fact that, while the pump is one of the most important items from the engineering standpoint, it is only a minor item of cost. Another reason is that it does not obtrude itself into view, in fact, it seldom is seen or heard from except by the operating force. That, however, is after the job is "bought and paid for," and it is then that operators feel that they were truly the "forgotten men."

It is of the utmost importance to the engineers drawing up plans and writing specifications to take pains to provide for pumps of correct design and construction, as, naturally, under public letting it is only to be expected that the article furnished will be the cheapest that can get by under the specifications. Further, it must be admitted that on public work the manufacturers have less incentive to try to make good on their equipment or try to maintain their reputation than they do when dealing with private customers.

Fig. 1—An 8-In. Vertical Pump, Equipped with Its Own Thrust Bearings

Centrifugal pumps have the reputation of being able to pump everything and anything which can possibly flow and are used for a great variety of purposes, from handling clear water as for boiler feed, water supply, etc., to the handling of sand, gravel and large boulders as in hydraulic dredging. However, as with all engineering apparatus, versatility is only obtainable at additional cost and with a sacrifice of efficiency. The more circumscribed the condition of service can be made, the more efficient and satisfactory is the operation of the given apparatus.

In the case of sewage pumps the first step should be to limit the size of the solids which can reach the pump suction. This readily can be done by providing a screen in front, preferable of the mechanical type, which would exclude all large pieces from the pump suction. This will prevent frequent clogging of the pump, for although sewage pumps are termed "non-clogging," they are bound to clog now and then. Further, limiting of the passageways through the pump permits of a more efficient design with a consequent saving on power.

A still further argument in favor of screening, although having no connection with the pump, is that obstructions are less liable to form subsequently in the pipe lines and mains if the large solids are excluded from the system.

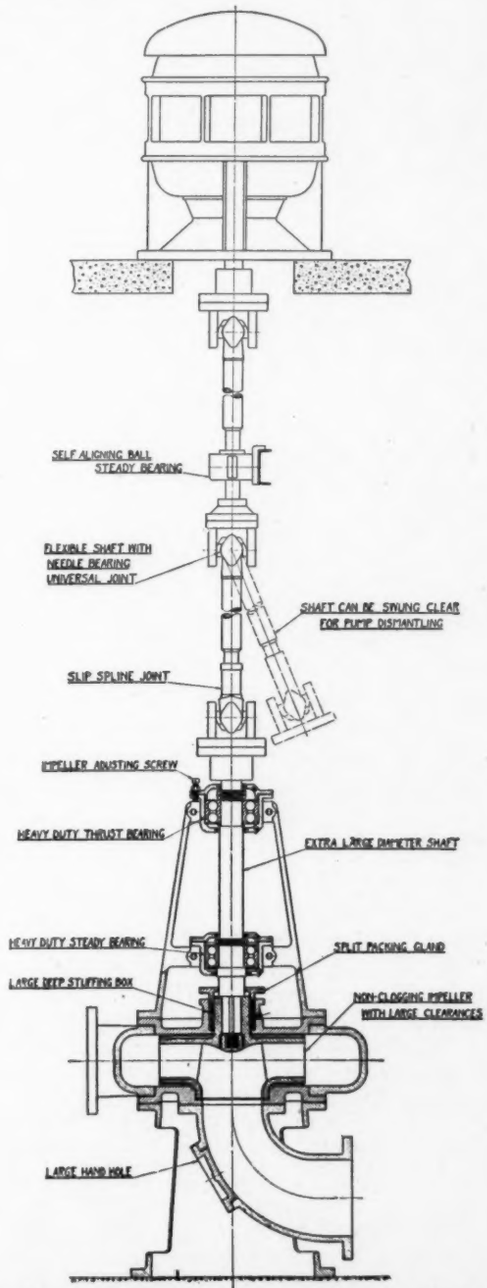

SELF ALIGNING BALL STEADY BEARING
FLEXIBLE SHAFT WITH NEEDLE BEARING UNIVERSAL JOINT
SHAFT CAN BE SWUNG CLEAR FOR PUMP DISMANTLING
SLIP SPLINE JOINT
IMPELLER ADJUSTING SCREW
HEAVY DUTY THRUST BEARING
EXTRA LARGE DIAMETER SHAFT
HEAVY DUTY STEADY BEARING
SPLIT PACKING GLAND
LARGE DEEP STUFFING BOX
NON-CLOGGING IMPELLER WITH LARGE CLEARANCES
LARGE HAND HOLE

Fig. 2—Section Through Vertical Sewage or Sludge Pump. Note Splintered-Joint Flexible Shaft Which Takes Care of Misalignment and Ease in Dismantling Pump.

*The author of this article has had many years of experience in the design and development of centrifugal pumps with an important pump manufacturer which pioneered in the centrifugal pump field. On this score he was asked to prepare this article for Water Works and Sewerage.—Ed.

The Meaning of Specific-Speed

The second point to consider in the writing of the specifications is the general design of the pump and impeller, as determined by the so-called "specific speed." This is a theoretical ratio derived from the following formula: $Ns = \frac{RPM\sqrt{GPM}}{H^{3/4}}$ where RPM indicates revolutions per minute, GPM indicates the capacity in gallons per minute, and H indicates the total head in feet developed by the pump.

This specific speed is merely a type characteristic for impellers which are geometrically similar, and is constant for different speeds and different sizes. It has no relation to the RPM except that impellers of high specific speed must operate at higher RPM for a given capacity and head than impellers of lower specific speed and vice versa.

For best all-round operation of pumps for handling sewage the impeller should have a specific speed of between 1300 and 2000 RPM, depending on the size of the pump, necessary clearances, etc. This will give a pump of good, conservative design with sufficient clearances for most requirements and possessing high efficiency and good wearing qualities.

There is a tendency at present towards pump designs of very high specific speeds requiring impellers of "freaky" designs and extremely small diameters. This undoubtedly is due to the fact that high speed pumps and motors are cheaper in the first cost. This initial saving, however, is obtained at a large increase in operating cost both for power consumption and for maintenance, because the efficiency of these extreme designs is necessarily low; and, in addition, the efficiency decreases very rapidly after the pump is put in service and wear begins to take place. This last is due to the fact that the wear on the impeller is considerably more rapid at higher RPM. Also, because the effects of the wear is far more pronounced on a small diameter, high speed impeller than it is on one of larger diameter and lower speed where the two are operating under like conditions.

As an extreme example of this we have one case of a manufacturer who put out a sewage pump with but a single vane impeller, but was forced to discontinue it because of the practical difficulties experienced in its operation.

Regarding motors, the motor speed need not be considered as a factor in the selection of a pump. This is because of the fact that geared motors now can be obtained to give any speed reduction desired and at but small additional cost.

Impeller Design

The next question to consider is the open type versus closed type impeller. Some manufacturers still continue to build sewage pumps with open impellers because they are cheaper and also under a pretext or a delusion that the open type impeller will not clog as readily and that it will help to grind up and cut up large solids which may enter the pump. This is false reasoning. For the same operating characteristics, the impeller must have vanes of the same width, whether open or enclosed type. In other words, adding a shroud on the front of the impeller does not alter the characteristics of the pump.

On the other hand, a centrifugal pump does not make a good chopper or grinder, even when equipped with open type impeller, and efforts to make it into such merely result in heavy wear between the impeller and the pump casing, and in frequent stalling of the pump due to pieces becoming wedged in between the impeller and the casing.

For reasons mentioned above engineers will do well to insist on enclosed type impellers for all pumps to handle sewage.

Vertical vs. Horizontal Pumps

The next point to consider is the choice between vertical and horizontal shaft pumps. The present tendency is toward vertical shaft pumps, and the fact that horizontal shaft pumps and motors are easier to maintain and look after is generally overlooked or ignored. This is very important in the case of sewage pumps because they are subjected to considerable wear, occasionally plugging, etc., and therefore require considerable more attention and expense for maintenance than do water pumps.

Vertical shaft pumps, on the other hand, have the

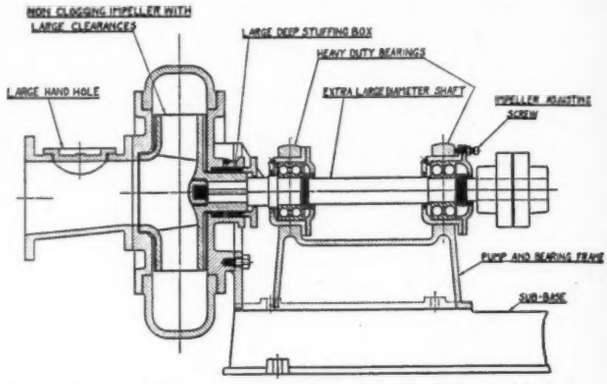


Fig. 3—Cross Section of Horizontal Sewage Pump. Note Large Hand Hole and Space in Front of Pump to Allow Easy Entry.

advantage that they take up less space, usually can be placed low enough so as to be self-priming, and permit of placing the motor out of danger of being flooded.

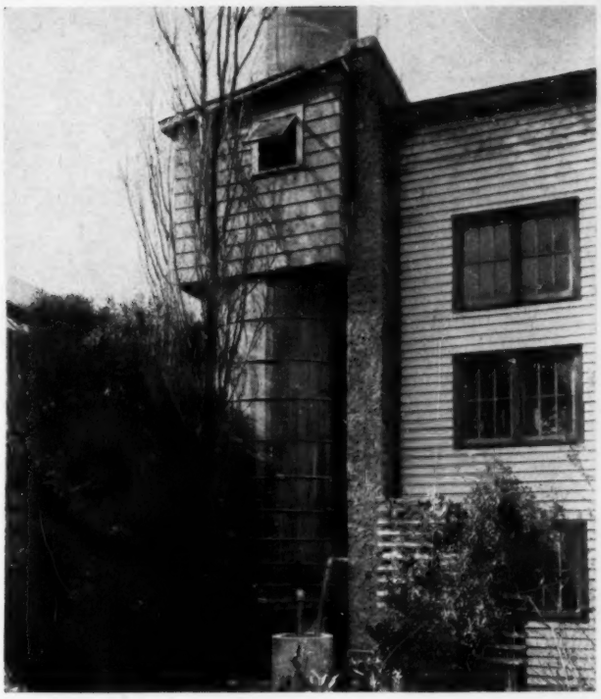
When vertical pumps are used they should be installed in a dry sump, never in a wet sump, that is, where the motor might be submerged. They should be readily accessible for repacking, etc., and the pumps should be made self-contained, that is, with their own thrust bearing, etc., as shown in Fig. 1. The pump should be connected to the motor through flexible shafting with splined joint to allow for misalignment and for discrepancies in height as shown in Fig. 2.

Sewage pumps should practically in every instance be installed in duplicate, or where that is impossible sufficient spares should be carried on hand to permit of making the necessary repairs or changes during a maximum allowable shutdown.

Provisions should be made for readily dismantling sewage pumps in case of clogging and for repairs. In case of vertical shaft pumps provision should be made to take out the impeller without disturbing the pump casing, the piping or the motor. This readily can be attained when the construction is that shown in Fig. 2.

In the case of horizontal shaft pumps sufficient space should be allowed in front to permit of disconnecting the suction pipe, and the pump casing should be provided with a disc in front to permit of opening up the pump as shown in Fig. 3.

A large hand hole should be provided in the elbow or fitting next to the pump suction to give ready access to the interior of the pump. The cover should be secured so that it can be opened readily and made so that it does not protrude into the channel and offer obstruction to the flow of the material. None but a long-sweep elbow should be used on the pump suction.



Modern Continuous Lime Treatment and Filtration Plant in a Florida Brewery. Capacity, 875 Gals. Per Hour.

MODERN WATER PURIFICATION IN THE BREWERY AND DISTILLERY

By F. J. LAMMERS
International Filter Co., Chicago, Illinois

BREWERIES and distilleries are very dependent upon proper water supply. In addition to requirements for their power plants and cooling systems, as in other industries, water of prescribed quality is the medium in which every step of processing occurs and it likewise comprises the largest part of the finished product.

Prior to prohibition, continuous methods of water purification were largely unknown in distilleries and breweries; today, progressive plants rely on improvements developed while the alcoholic beverage industry lay stagnant. Old-fashioned and round-about methods are giving way to modern, continuous forms of treatment and are creating major benefits in superior products, greater savings, and new plant efficiencies.

Brewing Water

Finished beer is 85 to 90 per cent water, the balance being materials in organic combination which directly or indirectly result from a water extraction of grain and hops. Different kinds of water make different kinds and qualities of beer, even when other factors are constant; hence the brewmaster or brewing consultant regards water quality as a factor of major potency in controlling his product.

Clarity: Brewing water should be clean and free from any appreciable amount of suspended matter, to prevent possible contamination of the finished product. If not initially clear, the water should be filtered; this is best carried out in sand filters of either the pressure or gravity type. In either case, proper consideration must be given to coagulation of the water ahead of the filter beds.

Tastes and Odors: Objectionable tastes and odors are obviously undesirable in the manufacture of any food product. Taste or odor in water have become an increasingly important problem for several reasons: chlorine is almost universally used to sterilize municipal supplies; increased amounts of industrial trade wastes are entering public supplies; and extreme variations in rainfall have intensified tastes and odors from natural causes.

Modern activated carbon purifiers make easy work of removing all objectionable tastes and odors from water, and the introduction of this equipment has proved to be one of the most striking recent developments in water purification. The beverage industry in particular has been quick to appreciate the advantages of this simple, efficient, and economical means of obtaining water of assured palatability. Consequently there has been a rapid and steady expansion in this finishing off treatment during the last five years.

Pressures operation, substantially automatic functioning, and small space requirements particularly adapt granular activated carbon units to this application. A hard, mechanically strong, and highly activated carbon must be used, and the shell of such a purifier must be equipped with a tasteless and odorless dielectric lining to prevent corrosion that otherwise would inevitably result from galvanic action between true activated carbon and any metal when wet.*

The water applied to an activated carbon unit should be clear and free from appreciable amounts of suspended matter so that the necessary intimate

contact between the water and the highly porous carbon may be obtained. If the water is not clear, the carbon particles will become coated with suspended matter; the pores will become clogged and the essential contact required for adsorption will be lost. Hence, if water to be purified in an activated carbon unit is not initially clear, it should be properly filtered beforehand.

Alkalinity and Hardness: Alkalinity of any kind is undesirable in brewing water, since it adversely affects the mashing extraction and tends to produce a harsher, improperly colored, less desirable beer for the American market. Because alkalinity in water includes bicarbonate (temporary) hardness, such hardness is undesirable for mashing water. Noncarbonate hardness, or hardness due to sulfates, chlorides, or nitrates of calcium and magnesium, is unobjectionable — is even desirable in moderate amounts.

Generally the most efficient method of removing objectionable alkalinity from the mashing or sparging water, used in extraction of the grains, utilizes continuous and automatic lime treatment and coagulation to precipitate the alkaline carbonates. Settling and filtration complete the removal of the precipitated impurities. When carbonate or bicarbonate of sodium is present, calcium chloride or sulfate is fed along with the lime in amount sufficient to transform the undesirable sodium carbonate to neutral sodium sulfate or sodium chloride; the carbonate radical precipitates with the lime as calcium carbonate.

This lime treatment reduces alkalinity to an unobjectionable amount, but also raises the pH of the water because of the slight excess of calcium hydroxide; however, quantitatively the amount of such alkalinity (total alkalinity) present is negligible. When desired, the pH and residual alkalinity may be quickly and easily reduced by lactic or phosphoric acid.

Undesirable alkalinity in brewing water also may be reduced by direct neutralization of the unsoftened water with lactic or phosphoric acid, but when treating waters containing any appreciable amount of carbonate or bicarbonate hardness, these chemicals are so much more expensive than lime that the expense involved is excessive by comparison. Boiling will reduce bicarbonate alkalinity somewhat, but not to the degree required for typical American beers; it is expensive because of the waste of heat energy.

pH Correction: The matter of controlling the pH, or intensity of acidity or alkalinity, as well as quantity, has assumed a steadily increasing importance in the treatment of water for brewing. Generally speaking, for best results in the mashing process, the pH of the water used should be adjusted to neutrality—around 7.0. This pH correction may be carried out automatically by simple proportioning feeders that add any predetermined amount of lactic or phosphoric acid to the water, either ahead of or beyond the hot water storage tank.

The acid also may be fed in bulk at the start of the mashing operation, but this does not assure accurate measurement, proportioning, or distribution. Scientific control under such conditions is difficult or impossible; during the mashing operation the pH of the mash naturally drops to a value in the neighborhood of pH 5, thus preventing any check on the amount of acid used for the particular water condition.

Iron: Iron is a highly objectionable impurity because it produces turbidity and undesirable dark color or sediment in the finished beer; in appreciable quantities it may also impart a false taste. Iron may be removed by aeration and filtration, but this usually involves the necessity of repumping, which is inconvenient and expensive in industrial plants.

Iron removal can be carried out automatically and under pressure if desired, in a unique development made possible by the introduction of activated carbon units for dechlorination. This process, covered by pending patent application, utilizes the precipitation of ferrous iron by the oxidation and hydrolysis obtained in the presence of excess chlorine, the over chlorination dosage being automatically proportioned to the raw water. The insoluble iron precipitate thus formed can then easily be removed by sand filtration. Whatever excess of residual chlorine remains can be removed from all or any part of the effluent by means of an activated carbon purifier. Thus is produced an iron-free, palatable, and refreshing effluent. In addition to the advantages of simplicity and automatic pressure operation, this method of treatment avoids the introduction of undesirable oxygen which usually saturates the water as a result of ordinary aeration, with the attendant possibility of further corrosion which might cause the treated water to acquire more iron from the distribution system.

Lime treatment also will remove iron; this is convenient when water requires elimination of objectionable alkalinity in addition to iron removal.

Other Minerals: The presence of other minerals in water may have an appreciable effect upon the quality of the finished product. The presence of calcium sulfate and some sodium chloride, in particular, is desirable to assist favorable extraction and to aid subsequent brewing processes, especially fermentation and clarification. Calcium sulfate improves proper yeast growth and development. However, an excessive amount of these or other minerals may interfere with proper fermentation and lend an objectionable or off-taste to the finished beer. Concentrations of any *one* substance in excess of 300 parts per million, or *total solids* above 800 parts per million, usually warrants the special consideration of the brewing technologist. Excess of carbonate hardness responds to lime treatment with a reduction in total solids, but other mineral content can be removed, commercially, only by distillation. Reduction of total solids by electro-osmosis holds much promise, but this treatment is not yet generally practical for industrial capacities.

Organic Substances: The organic constituents of brewing water are usually not so important as mineral salts, but the water should meet the standard bacteriological requirements for drinking. If contamination is possible or known to be present, the water may be sterilized by using automatic hypochlorite or liquid chlorine feeders; after sufficient retention time has been provided for completion of the sterilization reaction, the purified water must then be dechlorinated. Activated carbon purifiers may here be used to excellent advantage for the necessary removal of all excess chlorine.

Inert organic matter in small amounts is unobjectionable, as boiling and coagulation in the brew kettle usually precipitates and remove it. Excessive

*Brandt, Millard (to Darco Corp.), U. S. Patent Reissue 18,967 (Oct. 10, 1933).

amounts, however, may persist even after the beer filters and may cause difficulty in the finished product by unavoidable deposition of sediment or formation of "haze" in the beer. In such cases, superchlorination (in connection with coagulation), settling, and filtration is indicated, followed by removal of all excess chlorine with activated carbon purifiers. Such treatment has been highly effective in wholly removing *objectionable* organic matter from water.

Wash Water in the Brewery: The water used throughout the plant for general washing and rinsing of beer pipe and equipment must be clean and free from objectionable iron, bacteria, and all possible sources of infection. The water should meet the U. S. Public Health Service requirements for drinking water. In addition, the water used in bottle washers and pasteurizers and for washing barrels or filter masse should be sufficiently soft to keep these materials free from scale or other deposition due to hardness. Softening for these purposes is frequently carried out to the greatest advantage with zeolite, whereas zeolite softening is entirely inapplicable to the brewing water itself. The wash water used for barrels and filter masse must be free from iron, which might contaminate the finished beer.

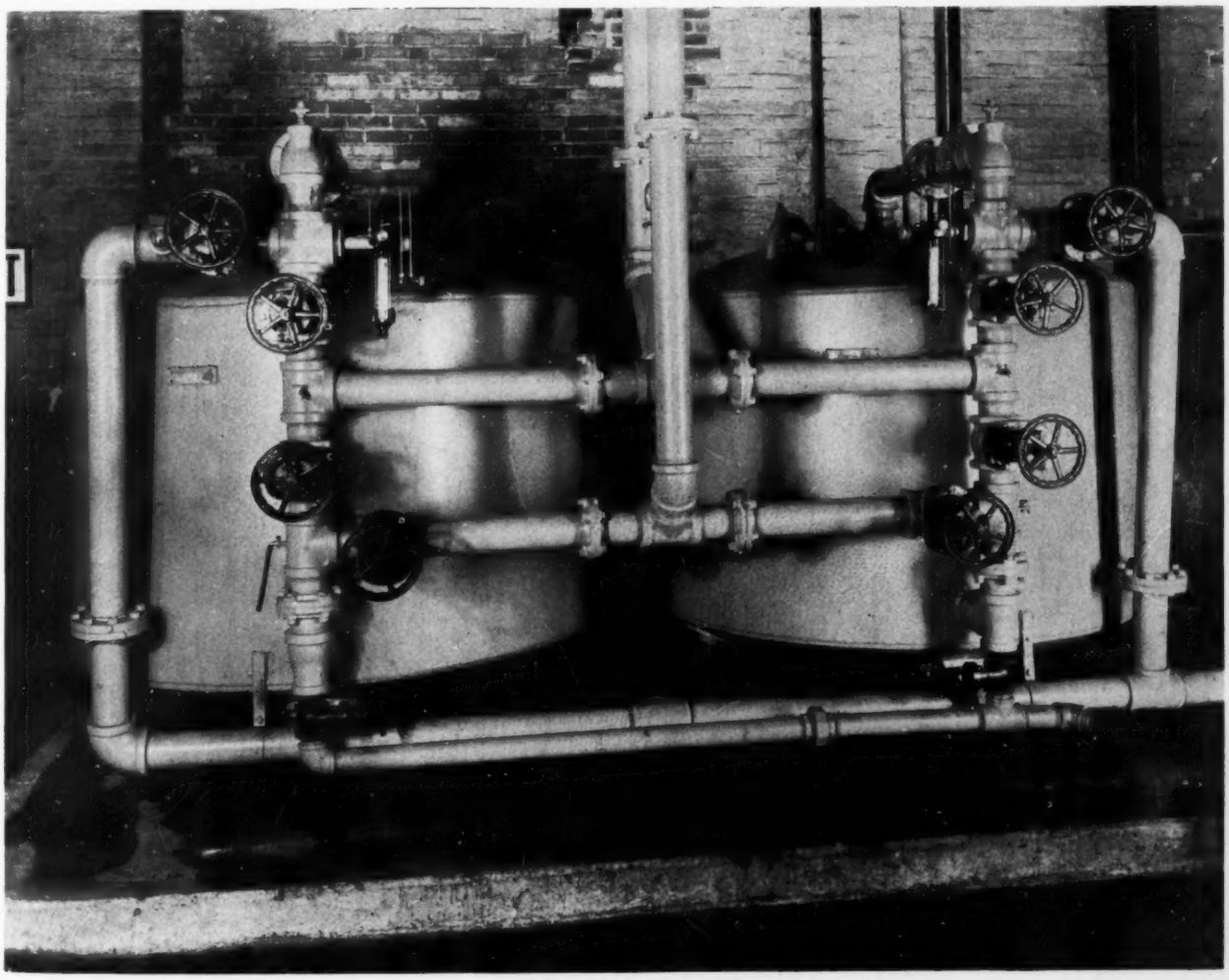
Power Plant

Boiler Feed Water: The usual requirements for boiler feed water must be met, i.e., clarity, freedom from scale-forming hardness, suitable sulfate-carbonate ratio to inhibit caustic embrittlement of boiler metal, absence of corrosive qualities, and freedom from high total solids or excessive organic matter that might induce foaming or priming. In addition, boiler feed water for brewery use must also be free from objectionable chlorine or other tastes and odors if process steam is to come in contact with the product.

Cooling Water: The circulating water used in cooling should be non-corrosive and free from hardness that will deposit scale on heat-exchange surfaces. It should not contain suspended matter, algae, or iron in appreciable quantities that might collect and obstruct water flow or transmission of heat. The cooling water requirements are in many respects similar to those for boiler feed, but they are less stringent, and the question of objectionable volatiles is not important in the usual closed cooling system. Generally, cooling water is most conveniently softened by the zeolite process.

The Distillery

Mashing Water: Since the distillation of the fermented mash in a distillery purifies as well as strengthens the product, mashing water requirements are less well defined; in fact, a certain calcium carbonate alkalinity may be preferred in some cases, since the more strongly flavored elements (congenerics) that result may lend definite character to the finished product after the numerous steps of process-



Installation of Activated Carbon Purifiers. These Units Have a Special Lining to Prevent Galvanic Action Between Metal and Carbon. Capacity 8,000 Gals. Per Hour

ing and purification. Clarity and freedom from objectionable tastes and odors are essential, nevertheless.

Boiler Feed Water: Boiler feed requirements in the distillery are similar to those in the brewery. More attention and control would be justified in handling distillery requirements because they usually involve higher boiler pressures and ratings; greater emphasis therefore must be placed on the exactitude and completeness of water treatment.

Cooling Water: Distilleries necessarily use large volumes of cooling water in coolers and condensers, and the large number of heat units thus passed into the cooling water represents a considerable portion of the heat energy and operating cost of the power plant. Any means of creating and maintaining better heat-transfer efficiencies is therefore most important; likewise, every possible means of recovering heat within the cycle of plant operation is valuable.

Cooling water treatment therefore becomes an essential, since heat exchangers, cooling coils, and condensers must be kept free from accumulation of scale or sediment. Zeolite softening is widely used for cooling water; previous filtration is indicated if the water is appreciably turbid. Excessive iron, algae content or filamentous bacteria may cause objectionable deposit on heat-exchange surfaces and obstruct water flow. Aeration or chlorination followed by filtration will remove iron, and simple chlorination—either alone or in conjunction with the feeding of ammonia compounds to form the more lasting chloramine—generally prevents objectionable algae or bacterial slime growths.

Large distilleries frequently collect spent cooling water in hot water storage tanks, from which it is taken as needed for processes using hot water. This creates an important heat saving but, as previously pointed out, the water characteristics and treatment methods of the cooling supply are generally the opposite of those used for process water. This is especially true of the mash supply. For instance, the proper treatment of water for cooling might easily be just the opposite of that required for mashing, and obviously it would be futile to treat water for cooling and then attempt to mash it with it under these circumstances.

This does not create an impassé, however, for simple heat exchangers will establish an efficient heat balance, conserving all possible heat energy and yet keeping the process water and cooling water systems separate, each with its individual, correct water treatment.

Distilled Water: Water employed in reducing or blending to produce the final product must not only be free from excess mineral water, but also devoid of objectionable tastes and odors. Commercial distillation will remove practically all mineral matter and solids from water, but it does not necessarily follow that the distilled water will be free from objectionable tastes and odors if such volatiles are present in the raw water.

Such impurities may volatize in the still and pass over with the steam into the condensing chambers, and therefore be found in the distillate. The extent of such volatile contamination of the distilled water may vary widely; a pronounced odor or taste may be evident in the distilled water, or the impurity may be so slight that its effect is not directly obvious. In any case, activated carbon purifiers are of great advantage in removing such off-tastes and odors in any concentration; this method of final purification for distilled water has already met with wide acceptance by the distilling industry.

Although the water obtained from a still is usually clean and clear, occasional particles of sediment may appear or be picked up from pipe lines or equipment; it is therefore advantageous to pass the distilled water through a disk filter. Rapid filtration through compressed cotton fiber disks, assures brilliancy and perfect clarity of the distilled water used in the finished products.

Undistilled Blending Water: In addition to the advantages of lower first and operating costs, undistilled blending water of low material content may be advantageous from an esthetic standpoint, inasmuch as fresh, palatable, natural water without excessive mineral content is more refreshing, pleasant and brilliant than the most carefully aerated distilled water.

When the amount of dissolved mineral matter in water is not great enough to cause precipitation of minerals or pectins, or otherwise to produce a haze when correctly mixed with the liquor, then the primary reason for distillation—removal of mineral matter—is obviated and proper chemical treatment of the water instead of distillation may be equal if not superior.

An installation that will assure undistilled blending water of ideal quality, provided the mineral matter content is satisfactory, consists of pressure units providing super-chlorination and coagulation, retention time, filtration and finally an activated carbon purifier. This will remove all undesirable iron and suspended matter and any objectionable tastes and odors, including residual chlorine. A disk filter, as the last unit on the line, is often included for final filtration to assure brilliant clarity.

Conclusion

Marked evolution in water purification plants—as in practically all chemical processes—has been the keynote during the last twenty years. Old batch treatment methods, with chemicals dosed and mixed by hand, are replaced by modern continuous treatment plants, employing the unit processes of chemical engineering in some of the most advanced forms.

Chemicals are fed automatically, in proportion to water flow or quality or both; new and highly efficient mixing, flocculation, and settling methods eliminate practically all manual supervision with attendant savings in space requirements and treatment costs. Chemicals are handled dry, in solution, or as slurries according to the most advantageous operation; improvements in sludge disposal systems shorten reaction time and yield a clearer settled water that imposes less load on filtration equipment.

Single control valves on filters and purifiers eliminate old-fashioned multi-valve fronts and plug-cocks, without any leaking, sticking, or lubrication. Rate-of-flow indicators and controllers indicate and maintain proper flow rates, visualizing operating conditions within the units and eliminating the human element.

The latest developments in many phases of chemical research—including adsorption, colloid chemistry, and reactions at the interface—play important roles in addition to the more familiar and fundamental reactions of general chemistry. With the developments of pure chemistry, combined with continuous flow and process control, modern water purification methods are evincing truly impressive progress, and must be considered not as accessories but

rather as fundamental to present-day plant operation —particularly those plants producing beverages and food products.

It is imperative, however, that each application be planned for its own set of requirements. A complete analysis of the water is indicated if any type of chemical treatment is considered. All possible seasonal variation in the water supply should be evaluated; surface supplies—particularly rivers and streams—vary from one season to another and call for corresponding variations in treatment.

The economic advantages of modern continuous treatment are particularly important in both the brewery and the distillery, not only because present processes offer improvements and savings over older systems, but also because water quality exerts a direct influence on the character and quality of product. As a result of this immediate effect on both product quality and salability, correct treatment has paid new, impressive dividends and is of major importance in modern beverage plants.

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A.W.W.A. Awards to Jordan and Braidech

Baker, Bartow, Hill, Henderson and Wall Made Honorary Members

The Board of Directors of the American Water Works Association have announced the following A. W. W. A. awards for 1936.

H. E. Jordan
Diven Medalist

M. M. Braidech
Goodell Prize Winner

To Harry E. Jordan, Chemical Engineer of the Indianapolis Water Company and immediate past-president of A. W. W. A., was voted the John M. Diven Medal. The Diven Medal is annually awarded that member of the association who has performed an outstanding service in the interest of the association. As most prominent of the several valuable services which the medalist has rendered, and is at present rendering, Mr. Jordan was selected for his efficient and laborious enterprise in directing the work of the Joint Committee of A. W. W. A. and A. P. H. A. on the Standard Methods of Water Analysis. Out of this has come a new edition of Standard Methods, now on press.

To Matthew M. Braidech, Senior Chemist, Water Department, Cleveland, Ohio, was voted the John M. Goodell Prize for his paper "The Spectrographic Determination of Minor Chemical Constituents in Various Water Supplies in the U. S. A. which appeared in the May, 1935, issue of the Journal of A. W. W. A.

Honorary Membership was bestowed upon: M. N. Baker, Montclair, N. J.; *Edward Bartow, Iowa City, Ia.; *Chas. R. Henderson, Davenport, Ia.; Nicholas S. Hill, Jr., New York, N. Y.; Edward E. Wall, St. Louis, Mo.; *Past-Presidents of A. W. W. A.

Fred Stuart to Head Activated Alum Corporation

F. E. Stuart

Fred E. Stuart, who for the past 5 years has served Industrial Chemical Sales Company as Research Engineer in the water purification field, resigned effective March 15th, in order to direct the activities of Activated Alum Corporation, in the water purification and sewage treatment fields.

Mr. Stuart, formerly City Chemist and Superintendent of Water Treatment at Daytona Beach, Fla., joined Industrial Chemical Sales Company for the purpose of introducing into water treatment its new product—AQUA NUCHAR—the pioneer powdered activated carbon in water treatment. The success of Stuart's efforts and the efficacy of the product is attested by the fact that its use has grown to an extent that AQUA NUCHAR is now the leader of all products produced by the company.

Activated Alum Corporation has been formed for the purpose of introducing and marketing the novel "BLACK-ALUM" which is a compounded filter-alum containing activated carbon—hence the name **Alum.** The product is an invention of a water works superintendent who, having discovered the advantages and economy of introducing even a small quantity of AQUA NUCHAR into filter alum, patented the product. The growth of interest in this product, first produced by Pennsylvania Salt Manufacturing Company, has justified the establishment of the new corporation which has been successful in securing the services of Mr. Stuart to direct its activities. Among these will be the use of a Mobil Demonstration Unit (with laboratory) which will cover the country, introducing BLACK-ALUM into the water purification and sewage and industrial waste treatment fields as an economical and more efficient coagulant.

The new offices of Activated Alum Corporation are located at 80 Broad Street, New York City.

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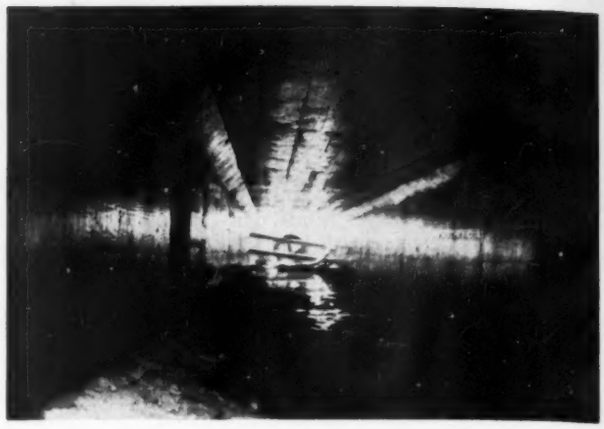
Mobil Water Softening Exhibit

Crane Company of Chicago has found its traveling exhibit of a complete domestic water system, on a small scale, both instructive and profitable in educational as well as sales work.

Traveling Exhibit of Crane Co.



Atlantic City Sewer Shortly After Coating with "Inertel," Still in Good Condition After 9 Years of Service

TREATED CONCRETE WITHSTANDS SEWAGE GASES

By C. G. WIGLEY, C.E.*

Atlantic City, N. J.

THE failure of apparently good quality concrete structures in the presence of gas from sewage, has been frequently described in engineering periodicals. In many of the cases on record there has been no question but that the supervising engineer had constructed as good a quality of concrete as was possible at the time.

The Author

There was a failure of this kind which affected a short concrete sewage conduit in Atlantic City. Briefly summarized, the main facts are as follows: For six years after construction the conduit in question was not put into use. Although constructed where the work was exposed to weather, there was no apparent disintegration of the concrete during this period. Six years after the conduit was put into service to convey sewage it was found to be badly corroded internally. It was repaired, but after another six year interval most of the upper portions of the work completely failed, requiring major replacement of the concrete.

*Former Chief Engineer, Atlantic City Sewage Co.

The Atlantic Sewer That Asphalt Paint Failed to Protect Against Hydrogen Sulphide

In the fall of 1915, the construction of the main sewage treatment plant for Atlantic City, on the salt marshes between the ocean and the mainland, was begun. After considerable concrete work had been placed, including a detritus chamber 110 feet by 15 feet by 6 feet deep and a concrete conduit six feet wide and three and one-half feet high and two hundred feet in length, the work was stopped on account of the war and the necessity of releasing labor for other purposes. These concrete structures were not put into service for several years thereafter. During a period of about six years the concrete was exposed to the weather. The winter of 1918 was particularly cold and the structures had been subjected to severe frost action.

The Writer's Experiences

In the winter of 1921 and 1922, at which time the writer became associated with the work, it was decided to complete the existing work and place that much of the plant in operation. At this time an inspection of the existing structures showed that the concrete was hard, rang under the blows of a hammer, and was difficult to cut through. It appeared to be a concrete of a durable quality. Since it was known that the sewage contained considerable quantities of hydrogen sulphide the interior of the conduit was painted with an asphalt paint, with the thought of protecting it, before it was put into service. In addition, large openings were cut at each end of the conduit to vent it. Later the opening at the outlet end was closed with a board cover because it proved to be a source of odor nuisance.

Six years later, in the Spring of 1928, it became necessary to cut through the conduit walls to connect to it newly constructed settling tanks. At this time it was found that the interior of the walls and along the underside of the roof of the conduit were soft and corroded. The corrosion was all above the flow line of the sewage in the conduit. There, the concrete on the interior of the conduit was of the consistency of a very weak putty, studded with gravel. With an ordinary lead pencil it could be dug out to a depth of two inches, being worse at the closed end of the conduit. Below the flow line of sewage in the conduit the walls and floor were hard. It was found that where the original

surfaces were still in place that they were coated with a gelatinous growth of bacteria or some higher organism. Unfortunately this growth was not identified.

During this period the sewage leaving the detritus tanks passed over an ogee—type weir to reduce splashing. Even under these circumstances there was a noticeable release of hydrogen sulphide at this point as the sewage entered the conduit. It might be thought that the disintegration would be worse at the inlet end of the conduit where gas ebullition was strong. Our investigation, however, showed the reverse to be the fact. The walls and roof of the conduit at the open inlet end, and for approximately half the length, were little if any affected. From that point to the closed outlet end the corrosion became increasingly severe. From this fact it was thought that possibly the slimy growth observed upon the walls was an important factor in oxidizing the sulphide gas to sulphurous or sulphuric acids and consequently attack the concrete, which was otherwise sound.

Conduit Repaired

Immediate steps were taken to repair the work, by removing all loose and corroded concrete. The concrete surface beneath was then washed with water under pressure and wire brushed, to remove the disintegrated mortar down to a hard firm base. The side walls and roof were then plastered by hand with a cement motar consisting of one part of cement to two and one-half parts of washed sand. Due to the constricted working conditions it is probable that this work was not done as efficiently as would be possible in other cases. After the walls and roof had received plaster sufficient to bring them to the original thickness they were painted with several coats of a commercial asphalt paint, recommended for the special protection of steel or concrete work.

At this time the flow of sewage was diverted from the conduit through the newly constructed settling tanks. However, about 60 feet of the discharge end of the conduit was still kept in service to carry off the tank effluent to the outfalls.

Six years later in March, 1934, the roof of the conduit collapsed (see picture), necessitating considerable reconstruction of it.

Material Found That Seems to Stand Up Against Sewer Gas

As compared with the above the following will possibly be of greater interest to engineers. In 1927 (a year before the conduit mentioned above was repaired) there was constructed in the vicinity of the main pumping station a concrete box sewer four feet by six feet, through which flows the *same sewage* that some fifteen minutes later arrives at the sewage treatment works. In the design of this costly sewer, every possible consideration was given the matter of protecting the inner walls from the corrosive action of gas from the sewage known to contain noticeable quantities of hydrogen sulphide. It was believed that the protective coating should have, as nearly as possible, the following qualities:

(1) Should *not crack* upon drying; (2) Should *not peel* off under any circumstances; (3) Should be gas proof and *acid proof* or inert to any chemical action to which it might be subjected; (4) Should *penetrate* the *concrete* to an appreciable depth; (5) Should be *smooth and hard;* (6) Should be fairly *permanent* to obviate frequent repainting. Among the different products which were suggested for this work, "Inertol" (a coal-tar base protective material, manufactured at the Inertol Co., Inc., of New York City) appeared to have the most satisfactory performance record. It had been used in Europe with considerable success under conditions which were judged to be similar to those at hand. It had been used 2 years previously on all of the Imhoff tanks and channels of the sewage treatment works at Trenton, N. J., and, upon investigation, was found to stand up very well under the conditions existing at that plant. Accordingly, it was decided to use this paint which was applied to the concrete by brush in two coats a few days after the forms were stripped.

A recent report shows that the concrete surfaces of this conduit are without any sign of corrosion, and also that the hand brushed coating is in tact, after 9 years of service.

The above experiences are cited for the benefit of engineers or others, who may find themselves in the same perplexing situation which confronted the writer while in charge of the Atlantic City sewerage system 10 years ago. At that time protective coatings had not been sufficiently demonstrated to render a selection for pipe and sewer protection more than a gamble. In fact, two trials had already met with failure.

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Association Meetings Scheduled:

March 19—**New England Water Works Association.** Statler Hotel, Boston, Mass. Sec'y, Frank J. Gifford, Room 613, Statler Building, Boston, Mass.

March 19-20—**New Jersey Sewage Works Association.** Stacey-Trent Hotel, Trenton, N. J. Sec'y, John R. Downes, Bound Brook, N. J.

March 23-25—**Kentucky-Tennessee Section, A.W.W.A.** Lexington, Ky. Sec'y, F. C. Dugan, State Board of Health, 532 W. Main St., Louisville, Ky.

March 26-27—**New York Section, A.W.W.A. (Spring Meeting).** Oswego, N. Y. Hotel Pontiac. Sec'y, R. K. Blanchard, Neptune Meter Co., 50 W. 50th St., New York, N. Y.

March 31, April 1-2—**Florida Section.** Tampa, Fla. Sec'y, J. R. Hoy, Wallace & Tiernan Co., 404 Hildebrandt Bldg., Jacksonville, Fla.

April 1-3—**Canadian Section, A.W.W.A.** Royal Connaught Hotel, Hamilton, Ont. Sec'y-Treas., A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto, Ont., Can.

April 2-3—**Michigan Sewage Works Association.** Michigan State College, East Lansing, Mich. Sec'y, W. F. Shephard, State Dept. of Health, Lansing, Mich. (Sewage Works Operators' 3-day Short School (March 30-April 1) precedes Conference.)

April 7-9—**Southeastern Section, A.W.W.A.** Hotel De Soto, Savannah, Ga. Sec'y. W. H. Weir, State Board of Health, 135 State Capitol Building, Atlanta, Ga.

April 7-9—**Indiana Section, A.W.W.A.** Purdue University, Lafayette, Ind. Sec'y-Treas., John A. Bruhn, Indianapolis Water Co., Indianapolis, Ind.

April 8—**New Jersey Water Works Association.** Trenton, N. J. Sec'y, William C. Flanders, 916 Lake St., Newark, N. J.

April 9-11—**Kansas Water Works and Sewerage Association.** Lawrence, Kan. (University of Kansas). Sec'y-Treas., Ernest Boyce, Chief Engr., State Department of Health, Lawrence, Kan.

April 10-11—**Illinois Section, A.W.W.A.** Evanston, Ill. Sec'y, W. D. Gerber, State Water Survey, 811 W. Oregon St., Urbana, Ill.

April 17-18—**Montana Section, A.W.W.A.** Butte, Mont. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

April 21—**New England Water Works Association.** Hartford, Conn. Sec'y, Frank J. Gifford, Room 613, Statler Bldg., Boston, Mass.

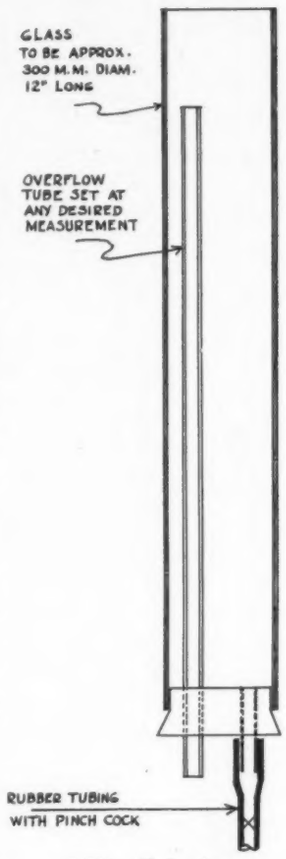
June 8-12—**American Water Works Association. (Annual Convention.)** Biltmore Hotel, Los Angeles, California. Sec'y, B. C. Little, 29 West 39th St., New York City, N. Y.

B. O. D. Bottle and Filling Tube

By B. D. ARCHER*

I will give a brief description of a filling tube and bottles used in B.O.D. determinations in the Laboratory of the Winston Salem, N. C., Sewage Works.

The filling tube here sketched is used to fill dilution water into bottles. I use a regular pharmacist's dispensing bottle, which serves very well for this purpose. It is of 250 m. l. capacity. The filling tube consists of a glass cylinder 12 inches long and approximately 300 m. m. in diameter and an overflow tube of approximately 5 m. m. bore, of any length desired, and one two-hole rubber stopper and one piece of small rubber tubing. The overflow tube is set at any height in cylinder for a given amount to be measured. The volume of water or liquid can be tested in graduated cylinder and the overflow tube raised or lowered for the required amount.



Filling Tube for B.O.D. Work

The B.O.D. bottle consists of a half-pint milk bottle with a glass stopper from a 250 m. l. re-agent bottle. By inverting the stopper in the mouth of the milk bottle and with a small amount of valve grinding compound and rotating back and forth for two or three minutes, a perfect ground joint can be secured. The bottle can be thoroughly and easily cleaned. I also find a water seal is formed if the stoppers are slid in at one side rather than with a straight down motion.

The reason for using this bottle is the ease of cleaning, which I have already mentioned. Sharp shoulders are eliminated. I find that 250 m. l. re-agent bottles cannot be cleaned except by chemical cleaning solution. I find my errors are far less with the milk bottles than any I have used to date. The stoppers can be secured from Arthur H. Thomas Co. for 5 cents each.

*Chemist, Sewage Treatment Works, Winston Salem, N. C.

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Golden Anniversary For Stewart Iron Works

Established since 1886, The Stewart Iron Works Company, of Cincinnati, Ohio., is this year celebrating its 50th year in business. The company manufactures plain and ornamental fencing and gates of iron, general ornamental iron and wire work; and, in recent years, chain-link wire fencing for industrial and municipal use. Mr. R. C. Stewart, now president of the company, learned the trade in the small Iron Shop of his father. Today, the fourth generation of Stewarts are engaged in the business started a half century ago in Wichita, Kansas.

In 1894 the two brothers, R. C. and W. A. Stewart, moved their small enterprise to Cincinnati, where rapid expansion soon followed their successes. In 1903 a new factory was built across the river in Covington, Ky., and today Stewart Iron Works Company has the name of being one of the largest and most successful concerns of its kind in the world. The present plant of "The World's Largest Builders of Steel Picket Fencing," with 350,000 square feet of floor space and equipped with the most modern sheet and bar iron and wire working machinery, is a far cry from the Stewart's humble Wichita "Iron Shop" of 1886.

Stewart Iron Works Company is a recognized leader in the fencing industry and the founder and his co-owners can be justifiably proud of the fact that Stewart products, wherever exhibited, have received highest awards for quality and excellency of craftsmanship.

Besides fencing, the company supplies municipalities with ornamental park furniture, ornamental railing, sidewalk gratings, street-sign frames, manhole-step irons, flag poles, ornamental grille work, weather vanes, and the like. Its imposing list of satisfied customers sounds like the "Who's Who" guide in society and industry.

On this Golden Anniversary, WATER WORKS & SEWERAGE takes opportunity to congratulate Mr. "R.C." (the founder), his sons, and his son's sons on Stewart products and the richly deserved reputation of The Stewart Iron Works Company the world over.

At the White House

Group of Member Editors of the National Conference of Business Paper Editors (A. B. P.) Who Convened in Washington February 14th-15th for Two Days of Interviews With New Deal Leaders and High Government Officials. The Above Picture Was Made Following a Half Hour Conference With the President

EDITORIAL

Education Too Slow—Experience Too Dear

ON another page of this issue there appears a news-item concerning an accident at the new Bristol, Rhode Island, sewage treatment plant. There, an explosion, caused by digester-gas escaped into the control house, considerably damaged this structure and the equipment contained. Fortunately no personal injury resulted, due to the fact that the explosion occurred during the night when operators were off duty.

In studying the probable causes of this accident, some important considerations come to light, and with them some equally important lessons are to be learned, both in the matter of design and operation.

Probably the most important lesson which develops from the Bristol experience is that the handling of sludge-gas must be given the careful consideration that this valuable but highly dangerous material deserves. City authorities and their engineers can ill afford to allow contractors to cut-corners on expense and install equipment for handling sludge-gas which is other than of proven dependability and safe in design. In making installations contractors and plumbers cannot be left to their own ideas as to the necessity or non-essentiality of any of the elements of design, or units, or specifications covering gas handling equipment which must be incorporated for safety.

Saving a few dollars through the utilization of substitute or plumber-built equipment and ignoring a basic saftey requirement, (that of running all release piping from water seals, traps, drip chambers and the like to terminate out of doors) may prove highly costly in property if not human injury. Such appears, from available reports and questioning of those who know most about the situation, to have been the underlying cause of the Bristol explosion. Not only will this cost the city many times the meager savings on the original contract, to repair the damages, but it will also bring to the attention of insurance interests the increasing hazards to be considered in making rates on sewerage property and lives and health of the employed personnel.

With the Woonsocket, R. I. digester explosion in their minds, as a fore-runner of the Bristol explosion, insurance rates on sewage-works involving sludge digestion, and operators of such plants, may become a very heavy charge, if available at any price. If Bristol alone had to suffer for its folly sympathy would be in order, but forgiveness is hard in the face of the fact that the accident, which seems wholly traceable to pinch-penny methods of construction, is to prove costly in insurance premiums to many other communities where ample safety has been provided. These cities and their engineers, who have given due regard to the small part of the total cost of sewage treatment plant construction which safety in gas handling equipment involves, are to be commended. They, however, stand to be penalized as the result of a few who fail to properly evaluate commercial gas handling equipment offered by manufacturers who have, at some expense, developed and proved its efficacy and dependability before placing it on the market.

Aside from the hardship on tax-payers, faulty design and accidents bring a more serious hardship on sewage works operators and their families, who little realize the dangers to which the operator may be unwittingly exposed through inexcusably curtailed safety measures. With the meager salaries of most operators, insurance of adequate value is difficult enough to maintain even at ordinary rates. To them the added hazard cost is serious.

A second, and another major factor, which the Bristol accident forces one to consider is that of operator qualifications. There seems to be a real lesson here. Backed by ample evidence, it seems highly improbable that a schooled or otherwise properly trained, or even a well experienced operator, would have failed to appreciate several things that were not alone basically faulty in operation, but especially so in the arrangement of the gas equipment and pipes at the Bristol plant. We find it difficult to believe that the implication, concerning the existence of faulty design, can be directed at the engineer or engineers charged with design of the plant. Too often original design and completed installation of equipment or plant appurtenances would hardly recognize each other, should they come face-to-face in drawings or specifications after the plant is placed in operation.

Too frequently the engineer's advice or warnings are not followed by City Hall's "experts" during construction. Justifiably a cause for resignation of the engineer, but too infrequently practiced for the good of the profession and incidentally (in the end) that of the municipality—perhaps. Still too infrequently does the consulting engineer who is responsible for design demand responsibility for the first year of plant operation, or even the appointment of an experienced and qualified operator. He may make an attempt to secure these desired conditions toward completion of the project, but he is then in no position to fight political situations. The correct occasion for this demand is at the time of drawing the original contract for his services; then insisting that responsibility for design and adequacy and proper function of the plant should be inseparable, ethically, morally, legally. All faults in design or performance reflect, justly or otherwise, on the designing engineer and he deserves to be given over the initial operation of his plants to preclude unjust damage to his reputation.

Concerning operator qualifications and reasonable demands for protection of property and life (likewise, the reputation of the designing engineer)—is not the biggest lesson of all, which comes out of the Bristol experience, that state regulations and Licensing Acts should be invoked to insure that only Licensed Operators with minimum requisite experience (above all, at least plain horse-sense) be allowed to operate our modern sewage treatment plants which have become something more than mere sewage works. Can we afford to leave such gas producing and gas utilization works, subject to proven hazards but poorly appreciated by those "experts" in City Hall, completely in their hands while they are becoming "educated" to the value of qualified technical operators? Are we wrong in our belief that experience, such as that gained at Bristol, continues to be a dear teacher and "education" too slow?

EQUIPMENT NEWS AND LITERATURE REVIEW

Cloroben

A chlorinated hydrocarbon for odor control is being offered under the trade name CLOROBEN by the Cloroben Corporation of Jersey City, N. J.

CLOROBEN is a heavy liquid, well known for its aromatic deodorizing and fly and insect repelling odor. An allied product is the better known solid Para-dichlor-benzine used in urinals as a deodorant and in homes (Mothine) for its moth repelling and destroying properties. CLOROBEN is being offered as an effective deodorant for application at sewage disposal plants, to septic tanks, privies, latrines, chemical toilets, cesspools and the like. Applied to the sewage proper, it exerts antiseptic effect which holds septic action and odor production in check. Especially effective has its use been in the odor free operation of institutional and camp plants when applied to the scum in septic tanks and the effluent. It is claimed that no interference with solids digestion has been noted. It has also been used in small municipal plants where sprinkling filter odors have been effectively controlled.

For further information and a sample, address The Cloroben Corporation, Jersey City, N. J.

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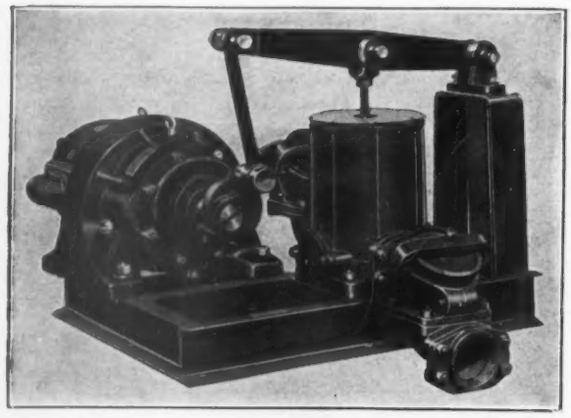
New Novo Sludge Pump

The Novo Engine Company, Lansing, Mich., some time ago perfected a horizontal-cylinder sludge pump which features the use of rubber roller-rings on the plungers, to provide a positive liquid seal without the use of plunger packing or diaphragms. These rings of ¾-inch live rubber, under compression between the cylinder wall and piston, roll freely wtih the piston strokes.

The newest Novo Sludge Pump, which embodies certain improvements, makes use of the same principle in the Single Vertical Cylinder Pump here illustrated. The plunger diameter is 10-inch (standard), whereas the capacity is varied by adjusting the stroke displacement (between 3 and 4 inches) to discharge 47 to 66 gals. per min. at the standard 47 strokes per minute. On specification, the unit can be supplied to operate at higher or lower speeds if conditions require it.

For a descriptive bulletin of this pump, difficult to adequately describe without cutaway illustrations, address Novo Engine Company, Lansing, Mich.



New Novo Sludge Pump

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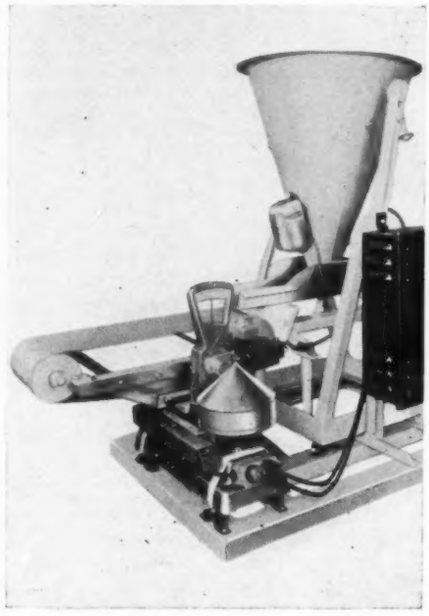
Syntron Continuous Weighing Feeders

The Syntron Company of Pittsburgh, Pa., manufacturers of the Syntron Electro-Magnetic (Pulsating) Chemical Feeders, are now offering an attachment which converts the Syntron feeder from volume feed control to the exact and continuous weight-feed control.

The new attachment (see illustration)



Syntron Gravimetric Filter

consists of a belt conveyor driven by a synchronous motor which travels at a constant speed regardless of possible variations in voltage of the power supply. The conveyor, counterweighted, is sustained in perfect balance as long as the rate of discharge from the pulsating feeder trough remains constant at the desired weight per minute. The scale on which the conveyor rests is equipped with two sensitive electric controls which speed up or slow down the trough and hopper pulsation (thereby the rate of speed) to maintain the belt conveyor in balance by feeding on to it a *constant load.*

For descriptive folder address Syntron Company, 400 N. Lexington Ave., Pittsburgh, Pa.

Haering Proportional Feeders

D. W. Haering & Company of Chicago have recently announced the development of three new Proportional Feeders for chemicals in solution, such as hypochlorite, ferric chloride and other corrosive solutions.

The new feeders employ the direct transmission of pressure differentials from pitot tubes, utilizing the Haering principle of liquids as fluid pistons, to effect efficiency and economy in operation. The Corrosive Solution Feeder incorporates sight feed indication, for the first time, in which the volume of solution per minute is readily observed and checked. No pistons or diaphragms are involved in the Haering feeders, which reduces first cost as well as maintenance and operating problems.

For descriptive booklet illustrating and showing applications of the three new Haering Proportional Solution Feeders, address D. W. Haering & Company, Inc., 3408 Monroe St., Chicago, Ill.

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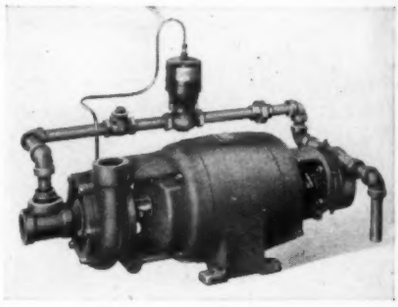
Automatic Self-Priming Monobloc Pump

The Worthington Automatic Self-Priming Monobloc Pump is a unit of many uses. The unit is equipped with a Worthington-built HYTOR primer (right) which is placed on the same shaft with the pump and motor. When the pump is effectively primed a pressure-operated cutout automatically unloads the HYTOR. There is no recirculation of water, nor are there any floats or valves to give trouble. The unit, which is compact and neat and powered by a modern splash-proof motor of streamline design, is available for single or polyphase



Worthington Automatic Self-Priming Monobloc Pump

50 or 60 cycle alternating or for direct current operation.

For descriptive literature ask for Bulletin W-323-B3. Address Worthington Pump and Machinery Corporation, Harrison, N. J.

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Streamlined Air Blowers and Gas Meters

Roots-Connersville Blower Corp., of Connersville, Ind., have recently developed two large blowers for sewage disposal plants, which incorporate several novel features of design.

These blowers, built on the rotary positive principle pioneered by Roots-Connersville, present a stream-lined appearance as a result of providing all pipe connections below floor level. Built for

top discharge, the ducts are carried down the side of, and integral with, the cylinder casting itself. Manual volume controls are built into these blowers, and provide a quick and simple means of varying the capacity of the units to meet changes in the plant requirements from day to day.

Roots-Connersville has also just announced additions to their line of Rotary Displacement Gas Meters which insure accuracy and low pressure losses (1 in. water head) in measuring sludge gas.

For literature and additional information, address Roots-Connersville Blower Corp. (W. & S. Div.), Connersville, Ind.

WITH THE MANUFACTURERS

Crane Establishes Division of Research and Developments

In order to more effectively bring about improvement of existing products, to originate new lines and to develop basic design, patents and inventions, Crane Company of Chicago has recently established a new Division of Research and Development which is to be directed by Mr. W. M. Link, former chairman of the Committee on Products.

The growing importance of and the volume of work of a research nature, conducted by various departments of the company in the past, seemed to justify a special headquarters division to handle all research and developmental work—in laboratory, shop and field. Studies of materials, manufacturing processes, advancement of standardization, and new applications of products will constitute a major consideration. Under the new Research and Development Division has been established a Product Engineering Department in charge of Mr. C. A. Dopp.

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W. E. Haywood Made N. E. Representative P. E. Meter Co.

The Pittsburgh Equitable Meter Company and subsidiary, the Merco Nordstrom Valve Company, announce the appointment of W. E. Haywood to its sales staff. Mr. Haywood will cover the New England territory and will sell Pittsburgh Water Meters, EMCO Sewage Gas Meters and Pressure Regulators and Nordstrom Lubricated Plug Valves.

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J. L. Hodgson to Represent National Water Main Cleaning Company

J. L. Hodgson of Atlanta, Ga., now represents National Water Main Cleaning Company in the Southeastern States. He also is representing two other firms in the water works field—A. P. Smith Manufacturing Company of East Orange, N. J., and Joseph G. Pollard Company of Brooklyn, N. Y. Mr. Hodgson's offices are in the William-Oliver Building, Atlanta, Ga.

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Pittsburgh Meter Company Studies Foreign Developments

Mr. F. Niesemann of the Research Department of the Pittsburgh Equitable Meter Company has recently returned from a European trip for the purpose of studying foreign methods of precision meter manufacture and the latest developments in that field abroad. By reciprocal arrangements, previously made between Col. Rockwell, president of Pittsburgh Equitable Meter Company, and foreign companies, Mr. Niesemann secured valued information and options on numerous new developments.

A native German, Mr. Niesemann was at one time a designing engineer in the Flow Meter Department of Julius Pintsch Company and Siemens & Halske Company of Berlin, and has to his credit a number of inventions pertaining to water meters.

As a result of these recent negotiations, Pittsburgh Equitable Meter Company promises some radically new developments which are to be announced later.

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Improved Automatic Controls

Automatic Control Company of St. Paul, Minn., announce that they will henceforth market all automatic control equipment manufactured by them, for water works and sewerage systems, under their own name. The original names TANKTROL and SELECTROL will be resumed. Also the same equipment, of recently improved design at reduced rates, will be sold by Minneapolis-Honeywell Regulator Company and the Brown Instrument Company through their several sales offices. TANKTROL is the improved instrument formerly marketed as L-550 for Pump Control; SELECTROL the improved instrument L-560 for Sewage Control. The mechanism remains essentially the same for each, the improvements being the new compact cast-aluminum instrument cases and improved floor and wall mountings. A new bulletin is available which illustrates 1936 Standard Models of TANKTROL and SELECTROL. The company also offers its experience in the design and building of special controls.

Address Automatic Control Company, 2590 University Ave., St. Paul, Minn.

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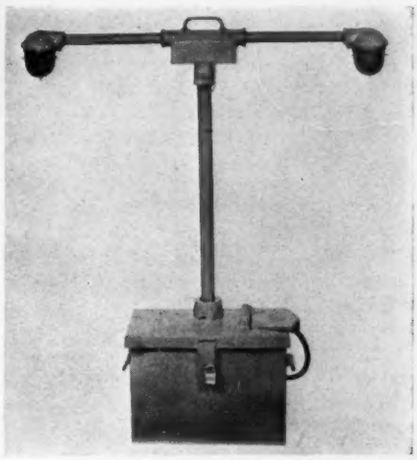
Flashing Warning Light

A new type of battery operated flashing warning signal for use in connection with repair work and construction productive of hazard, is being offered by Universal Safety Apparatus Company of Chicago.



Universal Flash Warning Signal

The device is entirely non-mechanical and employs the flashing light principle such as is utilized by railroads at crossings. It is, therefore, distinctive and highly effective as a danger warning signal. Its vital parts are hermetically sealed in to preclude interruptions due to atmospheric conditions. The unit illustrated will operate 134 hours between chargings of the storage battery, but a connection is available for use of commercial current, if desired, and several such units may be connected in series for trench-side use and the like.

For descriptive bulletin address Universal Safety Apparatus Co., 222 West Adams St., Chicago, Ill.

CATALOGS AND TRADE LITERATURE RECEIVED

[Any of the publications reviewed in this column can be secured from or through Water Works & Sewerage, if such is preferable.]

"Sparling Bul. 303":—Is a new 16-page bulletin describing and illustrating Sparling (propeller-velocity type) Maine Line Meters, of which there are now more than 5,000 in service, measuring water, oil and other liquids and for controlling rates of application of chemicals in proportion to flows. Indicating, totalizing and recording instruments of a variety of styles and adaptations are illustrated—also electrical transmitting equipment. A chart, which shows velocities and guaranteed accuracies at various rates of flow through various sizes of meters, reveals remarkably low head losses for all practical operating conditions, viz.—0.1 to 0.5 feet at velocities of 2.8 to 8.0 ft. per sec. Cutaway views of the Sparling Meter and indicating-recording instruments serve as a quick, excellent description in detail, from the stainless steel ball bearings to the aluminum-bakelite propeller and the Selsyn motor control. Directions for installation and

typical specimen installations are illustrated. A table of sizes, dimensions and capacity ranges completes the story. Bulletin 303 should be of interest to everyone interested in metering water and sewage effluents, or the control of chemical dosage at varying flows. Address R. W. Sparling, 945-51 N. Main St., Los Angeles, Calif.

"The Channel Valve":—A bulletin, which is as novel in makeup as the product described is new, has been produced (in their own print shop) by Ingersoll-Rand Company. The Channel Valve, henceforth to be used on all I-R Compressors, is a markedly new development in design of valves for air and gas compressors. The large ratio of port area to valve diameter makes for the desired slow speeds of air through the ports. The outstanding feature is that the opening and closing of the valve ports is checked against a cushion of air, trapped behind spring leaves within the series of channels which close the parallel ports—whence the name "Channel Valve." The impact cushioning results in the elimination of conditions which have heretofore been the most destructive to compressor valves. Likewise, reduced port velocities and impact elimination produces essentially silent valve operation.

Regardless of one's interest in improved compressor design and the novel valve, a real surprise in unique bulletin-design is in store for the reader who requests "The Channel Valve." Address Ingersoll-Rand Co., 11 Broadway, New York City.

"Everson Filters and Chlorinators":—Are described and illustrated in a recent brochure distributed by Everson Filter Company of Chicago. A complete swimming-pool installation of pressure filters, electrolytic type chlorinator and appurtenances, is illustrated. The Everson Safety Electric Chlorinator which generates hypochlorite solution from salt is described in detail, as is the Everson (All Purpose) Solution Feed Chlorinator which makes use of liquid chlorine. The Everson Chemical Solution Feeder for feeding hypochlorites or corrosive coagulants such as alum or the iron salts is also shown. An interesting "tool," described and pictured, is the Everson Self-Priming Portable Pumping Unit which comes mounted on small rubber-tired wheels and powered by gasoline engine or electric motor. For the complete 20-page loose-leaf brochure ask for "Plunge in Purity." Address Everson Filter Company, 627 West Lake Street, Chicago, Ill.

"Modern Aeration and Filtration":—Is release No. 4 in a series of this title being distributed by Norton Company of Worcester, Mass., well known manufacturers of porous plates and tubes for water and sewage treatment. The new brochure pictures several installations of Norton plates and tubes in typical sewage treatment plants from the smallest to the largest. On the last page appear typical modern specifications covering porous plates. To receive the current issue No. 4, back issues or future issues, address Norton Company, Dept. "S," Worcester, Mass.

"Steel Storage Tanks":—Is a 25-page bulletin published by Chicago Bridge and Iron Works. It contains specifications, notes on design, joint efficiency tables, and tables of capacity and dimensions of standard flat bottom steel tanks for storage of water, oil and other liquids. The bulletin also includes tables of circumference, areas of circles and volumes of cylinders; diameter, surface and volume of spheres; conversion factors, and several useful miscellaneous formulae for computing tank design to meet various requirements. Request Bulletin 11, "Steel Storage Tanks," Chicago Bridge and Iron Works, 37 W. Van Buren Street, Chicago, Ill.

"Master Paint Specifications":—Joseph Dixon Company, for many years producers of high grade industrial paints, has recently issued a reprint of pages taken from their catalog listing and describing the several Dixon paints of interest in the water works and sewerage field, particularly the protective Dixon Flake Silica-Graphite Paints, Dixon's Aluminum Graphite Paints and Dixon's Red Lead Graphite Primer. In an accompanying leaflet are given specific directions, specifications and recommended practice in cleaning and painting or repainting standpipes and elevated tanks, both inside and out. Springtime Is Paint Time. For the Dixon catalog and leaflet on "Water Tower Painting," address Joseph Dixon Crucible Company, Jersey City, N. J.

"Solution of the Pipe Corrosion Problem":—Is the title of a brochure from Cement Lined Pipe Company which discusses the "Why" of cement lined pipes during a 60-year record of use, reasons for present trends toward lining of pipes by modern methods, and suggestions for handling and installing cement lined pipes and fittings ¾ to 42 inches in diameter. The special advantages of cement linings are set forth and many successful applications listed. Address Cement Lined Pipe Co., Lynn, Mass.

"Sika":—Uses of the compound "SIKA," which is mixed with cement and applied as waterproofing and surface protection material for concrete and other structures (including sewers), are described in a reprinted report recently received. Applications in lining leaking structures and sewers are described and illustrated and results set forth. For a copy of this and other descriptive waterproofing literature, address Sika, Inc., 1943 Grand Central Terminal, New York City.

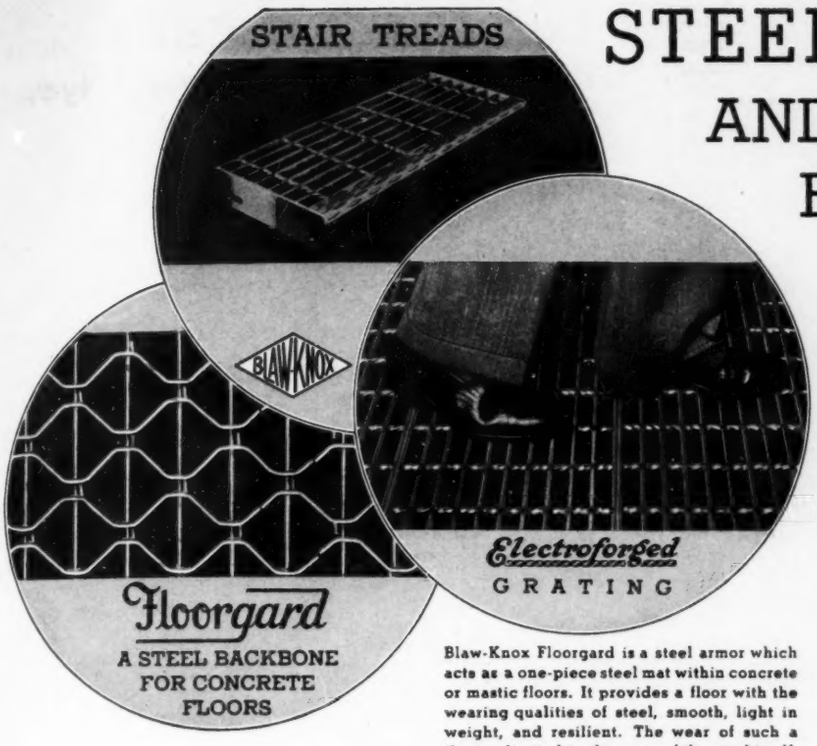
"Wind News":—Is a most attractive illustrated 16-page catalog. Friez of Baltimore, Md., describes and pictures with direction and velocity instruments and indicating and recording devices. The present-day need for keeping records of humidity, wind direction and velocity at sewage treatment works and other plants, subject to suits for odor nuisance, makes this catalog of interest to municipalities and sanitary engineers. A weather forecasting table is also included. Ask for "Wind News"; address Julian P. Friez & Sons, Baltimore, Md.

"How to Bronze Weld":—Is the title of a brochure from Linde Air Products Company of New York City, which summarizes the available information on bronze welding and bronze resurfacing. The step-by-step procedure in bronze welding of cast iron, wrought iron, brass, bronze et al. is given, as well as that of joining dissimilar metals. The use of the "all-purpose" welding rod is explained in detail. Other useful brochures covering the use of the oxy-acetylene torch in construction and repair work are listed in the rear. Address Linde Air Products Co. (Union Carbide and Carbon Corp.), 30 East 42nd Street, New York City.

"Burks Turbine Pumps":—From the Decatur Pump Company comes "The Story of the Burks Pump" and also Catalog No. 34 describing the several types of Burks Super Turbine Pumps which are high or low head true turbine pumps, in capacities of 25 g.p.m. and less, which are self-priming and suitable for suction lifts of as much as 28 feet. They are capable of pumping air or water (hot or cold) or mixtures of each, and consequently are well adapted to hot water condensate return systems. Also described and illustrated is a series of Burks Self-Priming Centrifugals for heavier loadings at lower heads. Claims of supremacy: A single moving part (impeller and shaft); balanced load: deep lift. Claim of distinction: On the up-to-date streamlined "Zephyr," it's the modern Burks Pump. For literature on "Burks Self-Priming Pumps" address Decatur Pump Company, Decatur, Ill.

"Black Arrow Pumps":—A six-page bulletin from Lawrence Pump Company announces the double-suction "Black Arrow" Single Stage "Vortex" Centrifugal Pumps in sizes from 2 in. to 14 in., with capacities from 30 to 10,000 gals. per min. against heads up to 300 feet. Other features: horizontal split casings and ball bearings. For Bulletin D-17, address Lawrence Pump and Engine Company, Postoffice Box 70, Lawrence, Mass.

"Portable Electric Welders":—From the Lincoln Electric Company comes a bulletin describing Lincoln "Shield Arc" Welders, including illustrations and specifications. At this season of winter, information on portable welding equipment for the double duty of pipe and main thawing and welding operations may be timely. For literature on "Portable Electric Welders," address Lincoln Electric Company, Cleveland, Ohio.



STEEL GRATING AND STAIR TREADS BY BLAW-KNOX

Blaw-Knox Floorgard is a steel armor which acts as a one-piece steel mat within concrete or mastic floors. It provides a floor with the wearing qualities of steel, smooth, light in weight, and resilient. The wear of such a floor is limited to the wear of the steel itself. Floorgard is easily and cheaply laid, maintains its true, smooth surface at all times.

Blaw-Knox Electroforged Steel Grating is one-piece construction, made without slots, bolts or rivets—rigid and will not rattle. The twisted cross bar provides non-slip footing but no obstruction to rolling loads. Easily painted—no cracks or crevices. Maximum open area for light and air. No acute angles to hold debris—self-cleaning.

Blaw-Knox Stair Treads have all the virtues of Blaw-Knox Grating plus a nosing made from rolled diamond checkered plate. This nosing is made to withstand great abuse. It defines the edge of each tread because of the very definite contrast between the checkered plate and grating construction.

COMPLETE LITERATURE ON THESE PRODUCTS WILL BE SENT ON REQUEST

BLAW-KNOX COMPANY

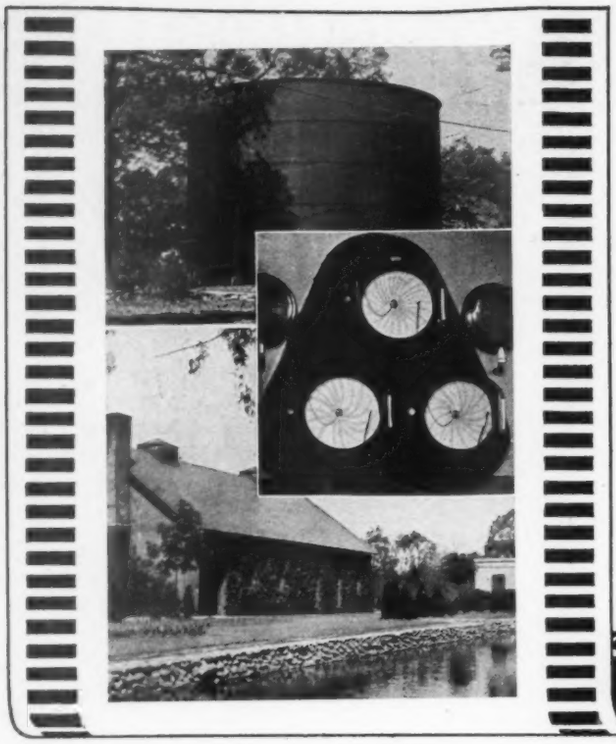
2053 FARMERS BANK BUILDING - PITTSBURGH, PA.

Clark-Sundh

Twenty years' experience in back of Sundh Automatic Control for Water Pumping Stations is one good reason for specifying this equipment.

We have specialized in this line of control. We meet the Engineers' specifications and design and build for permanence and reliable performance.

THE CLARK CONTROLLER CO. 1146 E. 152ND ST. CLEVELAND, O.



Chronoflo brings in levels of 3 tanks at Ridgewood, N. J.

The illustrations show:

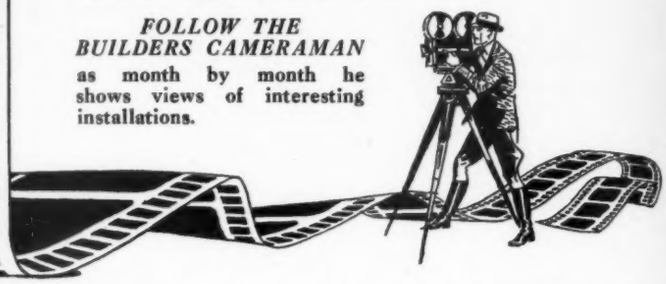
1. Glen Ave. Storage Tank 1½ miles away (the other tanks are ¼-mile and 2 miles away);
2. Chronoflo Level Recorders on Station Panel; and
3. Midland Park Pumping Station.

Nobody walks a step or climbs a tank! With these Chronoflo Recorders right in front of him the Engineer knows just how much water there is in each tank; and pumps accordingly.

Would Chronoflo be useful in your plant telemetering levels, flows, pressures, or other information from distant or nearby points to the place or places where that information can help most in improving operating efficiency?

More information on request.

FOLLOW THE BUILDERS CAMERAMAN
as month by month he shows views of interesting installations.



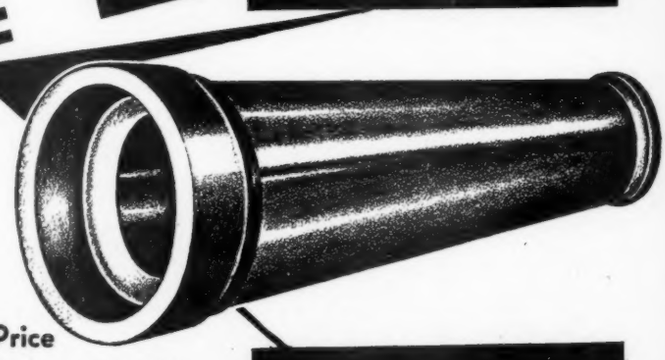
BUILDERS IRON FOUNDRY

9 CODDING STREET
PROVIDENCE • R • I •

Bulletin 260 — Venturi Meters for Main Pipe Lines
Bulletin 232 — Venturi Direct Acting Controllers
Bulletin 273—Chronoflo Telemetering System, transmitting flow, pressure, or level measurements for "hundreds of feet or hundreds of miles."

SAVE 1/2 on CAST IRON PIPE

36-INCH
BELL & SPIGOT
Class A
Standard 12-foot joints
Weight, 4250 lbs. per joint
Amount, 5000 tons



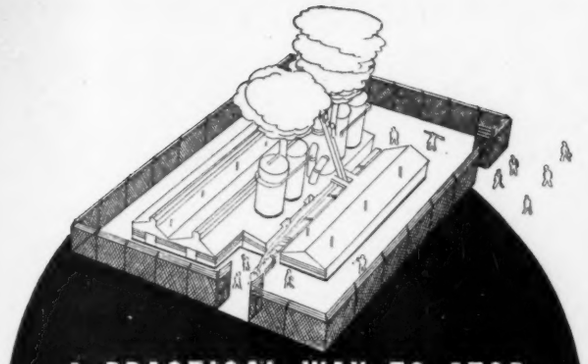
This pipe was purchased new in 1917. It has been passed on by the Pittsburg Testing Laboratories and stands hydrostatic test. Complete with valves and fittings. Available in any quantity. Write for descriptive photographs and copy of Pittsburg Laboratories preliminary inspection report.

Price
FOB Kansas City, Mo.
$20 Per TON
Valves and Fittings Included

48-INCH
BELL & SPIGOT
Class A
Standard 12-foot joints
Weight, 8000 lbs. per joint
Amount, 5000 tons

SONKEN-GALAMBA CORP.

64 NORTH SECOND STREET KANSAS CITY, KANSAS



A PRACTICAL WAY TO STOP PETTY THIEVING

Stealing from your storage yards and factory buildings is made comparatively easy, when your property is not enclosed in fence. Intruders and even employes find it easy to get away with material unless they are compelled to enter and leave through guarded gates. A Pittsburgh Chain-Link Fence solves this problem definitely and permanently. Designed and erected for heavy service it will resist the shocks of everyday use and give faultless service over a long period of years. We will be glad to furnish an estimate of cost of fencing your property. An inquiry will receive prompt attention.

Pittsburgh Fence

PITTSBURGH STEEL CO.

754 UNION TRUST BLDG. PITTSBURGH • PENNA.

"More Than 4,500,000,000 Gallons Per Day Pass Through SIMPLEX RATE CONTROLLERS"

Simplicity of Design, Accuracy, Dependability, Low Maintenance Cost, and Direct-Acting Features make SIMPLEX CONTROLLERS the selection of Designing and Operating Engineers all over the world.

YOU can better YOUR filter operation by their use.

A card will bring you complete data.

SIMPLEX VALVE & METER CO.
6743 UPLAND STREET, PHILADELPHIA, PA.

What will the voters say?

Imagine having the sewer lines in your community disintegrating years before you have even retired the bonds! This has actually happened in more than one California community—all because of H_2S, generated by sewage bacteria.

It's H_2S (hydrogen sulphide gas) which spreads sewer odors all over your community. In the sewer system, H_2S generates sulphuric acid in lines and plant. The acid attacks the lime in mortar and concrete—and there goes your investment, unless the trouble is eliminated.

More than a score of California communities avoid such hazards by treating sewage with Bear Brand Chlorine. Chlorine kills bacteria, thus preventing H_2S from forming, and it neutralizes existing H_2S. Chlorine treatment may also save money on plant operation, by speeding up treatment and improving plant efficiency. We will gladly send detailed information on chlorination. Just let us know your plant capacity and method of treatment.

Liquid Chlorine • Ferric Chloride • Ammonia

GREAT WESTERN ELECTRO-CHEMICAL CO.

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PLANT: PITTSBURG, CALIFORINA
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GREAT WESTERN ELECTRO-CHEMICAL CO. BEAR BRAND PRODUCTS SAN FRANCISCO CALIF.

THE

METER-MASTER

A Rate Recorder attachable to ANY water meter, single or compound.

•

The record of the meter is *not* interrupted. No batteries.

•

Has saved its cost in less than two months in several cities.

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Hear what users have to say about it.

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It will pay you to investigate this inexpensive, money- and trouble-saving instrument of many uses.

Write for information.

BRAINARD & HATCH

246 Palm St. Hartford, Conn.

ANTHRAFILT

for Lower Freight Charges and.... more Porous Filter Beds

The specific gravity of Anthrafilt is only half that of sand. This cuts shipping costs and makes for looser packing and higher porosity.

Since Anthrafilt can be used in larger sizes than sand without sacrificing quantity of finished water, there is less clogging, cracking, pulling away from side walls and, therefore, longer filter runs.

Samples, quotations and references without obligation.

THE HUDSON COAL CO.

SCRANTON, PA.

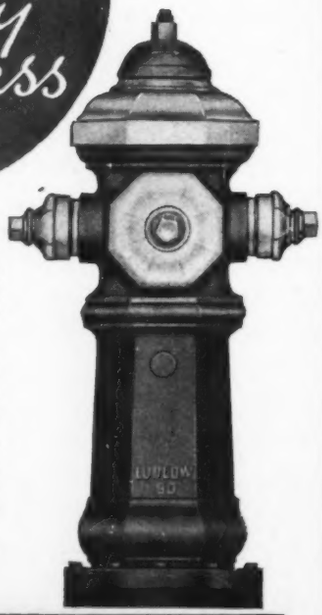
G. B. FILLMORE
General Sales Agent

LACKAWANNA "the D&H" ANTHRACITE

H. H. SHAVER
Asst. Gen. Sales Agent

LUDLOW

means Strictly First Class



Handsomely symmetrical—ready for action all the time—built for years and years of service—every point of Ludlow Hydrants is strictly first-class.

Compare: Full force—no obstruction in waterway. Non-freezing — drains from the bottom. Inside design — eliminates surges and water hammer. Replaceable without digging — breaks above ground in case of accident. Maintenance—all parts easily removable.

The LUDLOW VALVE MFG. CO.
TROY, NEW YORK

HYDRO-TITE

A Symbol of Quality

Dependable Always

Joint your cast iron bell and spigot water mains with dependable self-caulking Hydro-Tite.

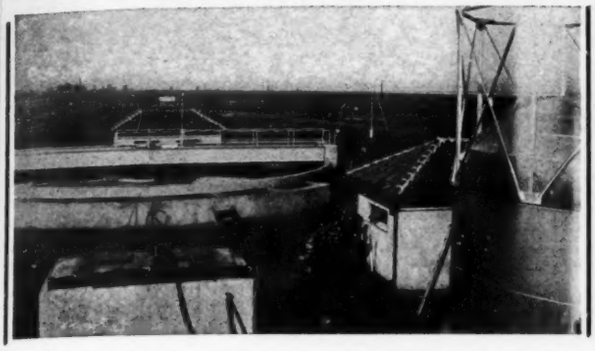
Tight—strong and flexible. Used on thousands of miles of pipe. In service more than 22 years without a failure anywhere.

Write for information or demonstration.

HYDRO-TITE

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.
General Offices and Works: West Medford Station, Boston, Mass.



Palo Alto, California, is just one of the many sewage plants protected throughout with

INERTOL
AFTER 8 YEARS' SERVICE

at Tucson, Arizona, our Western Manager, Mr. H. A. Knoedler, reports about our treatment as follows:

"The local Sewage Treatment Works were designed by Black & Veatch, Kansas City, Mo., in 1928 and treated with INERTOL throughout in accordance with their specifications. The INERTOL coating is still protecting the concrete in good shape and Mr. George W. Marx, the engineer in charge, states that it has prevented spalling and been a big help in maintaining a neat appearance of the tanks."

Hundreds of similar reports confirm the great service our products are giving on concrete and steel in numerous sewage plants from coast to coast.

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New York, N. Y.

Inertol

447 Sutter St.
San Francisco, Calif.

Profitable DITCHING

with Barber-Greene's

Barber-Greene's Superior features: the Vertical Boom, Milling Action digging, Automatic Overload Release, Self-Cleaning Buckets and many others give profitable digging. They bring results like 7c a foot for a Washington Water Department (partly through hardpan) . . . 5c a foot for a Texas Gas Company . . . 2½c a foot for hundreds of miles of pipe-line trench. Send a card for "Ditching Snapshots and Records." There is no obligation.

Standardized Material Handling Machines

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Clarifiers
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Attractive and Safe

THE many means of making a pool outwardly attractive and inviting are useless—if not dangerous—unless the vital, hidden equipment maintains **clean, clear, safe** water.

International Pool Equipment — Filters, Hydraulic Single Valve Controls, Chemical Feeders, Flow Indicators, Flow Controllers, Lint Catchers, Pool Cleaners, Fittings, Test Kits and Recirculating Equipment—provides undivided equipment responsibility and assures continually **attractive** as well as **safe** water.

Send for Bulletin giving typical layouts of the modern pool.

BULLETIN 2207—Indoor Pools
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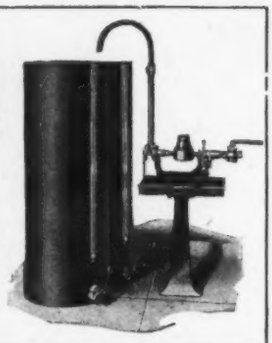
International Filter Co.
Water Softening and Filtration Plants
General Offices
326 East Van Buren Street, Chicago

INTERNATIONAL

The FORD METER TESTER for WATER METERS



Accurate, convenient and moderate in cost. Hundreds in use.

Machines are made for testing one to five meters and calibrated tanks are made in three sizes.

Write for information and prices.

WATER METER QUALITY EQUIPMENT

FORD METER BOX CO.

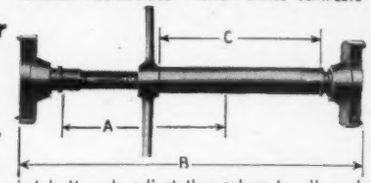
WABASH, INDIANA, U.S.A.

"ANCHOR" IMPROVED STEEL TRENCH BRACES

"ANCHOR" ADJUSTABLE TRENCH BRACE COMPLETE

Stronger → ← Stiffer

Heavier → ← Safer



Ball and socket butt ends adjust themselves to all angles. Strongest and stiffest brace made. Instantly adjustable to trench width. The only brace using special, high carbon steel tubing nearly twice as strong as ordinary pipe. Timber braces also. Fittings furnished. All sizes. Send for bulletin.

EDELBLUTE MANUFACTURING CO.

340 Jackson Street — Reynoldsville, Penna.

SERVICISED EXPANSION JOINTS

for

Sewage Plant Construction

Remember, when you are planning your new sewage plant, swimming pool or in fact any type of concrete structure, that the life of that structure depends on the joint filler you employ.

SERVICISED EXPANSION JOINTS are made to exacting specifications. Furnished in various types, such as Premoulded Asphalt, Cork Rubber, Sponge Rubber, Plain Cork, and many other types. They are made to prevent and control cracking of concrete, giving longer life to concrete construction however or wherever used.

Specify — SERVICISED Expansion Joints on your next concrete job.

Asphalt Plank Expansion Joint
Waterproofings
Asphalts
Fibre Plaster
Sheet Asphalt
Waterproofing
For Sewer Tunnels

SERVICISED PRODUCTS CORP.

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Section of Railroad Tunnel Under the East River, New York City, being waterproofed with—

Sika

Use Sika to stop the inflow of water through dams, walls of pump houses, man-holes, filter beds, sewage tunnels, etc. Sika mixed with portland cement is easily applied by hand and will successfully seal off infiltration from underground streams even under pressure.

Write us about your problems.

Sika, Inc.

1943 Grand Central Terminal, New York City

LOCAL WORK for MORE LOCAL WORKERS

LOCAL labor is not only used for the laying but also for the manufacturing of Lock Joint Pressure Pipe, thus greatly relieving the local unemployment problem.

Lock Joint Pipe Co. Est. 1905. Ampere, N. J.

LOCK JOINT REINFORCED CONCRETE PIPE

PRESSURE · SEWER · CULVERT

THE **NATIONAL** METHOD OF **WATER MAIN CLEANING**

WRITE FOR BOOKLET "The cleaning of water mains"

30 YEARS Experience

NATIONAL WATER MAIN CLEANING CO.

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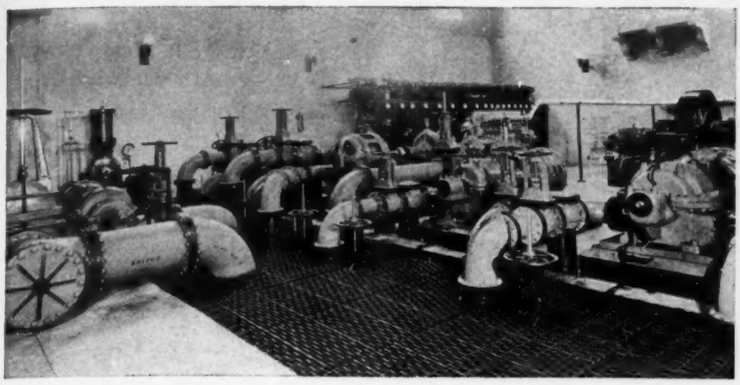
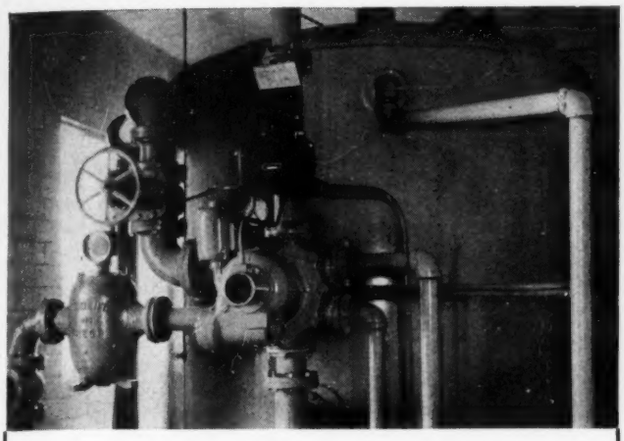


ACIPCO

Acipco cast iron pipe and fittings in pumping station, Ft. Dodge, Iowa. Acipco furnishes a complete line of fittings for both B&S and mechanical joint cast iron pipe. For literature write American Cast Iron Pipe Co., Birmingham, Ala.



EAST ROCHESTER, N. Y.

softens its municipal water supply with this Permutit fully automatic zeolite water softener. Such a plant offers many advantages: Small space requirements, uninterrupted service, minimum of attendance and absence of sludge disposal problems. Write for free copies of municipal water softening bulletins. The Permutit Company, 330 West 42nd Street, New York, N. Y. World's Largest Manufacturer of Water Conditioning Equipment.

Permutit
Water Conditioning Equipment

Make a PROFIT on your SLUDGE *with the* ROYER DISINTEGRATOR

The complete machine with electric motor. Other models gasoline or belt drive.

Used at
Birmingham, Ala.
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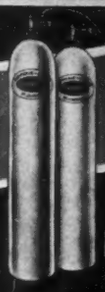
Monsanto LIQUID CHLORINE



A dependable product in dependable equipment

Manufactured by
Monsanto Chemical Company
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Chlorine is manufactured and shipped from our works at Monsanto (East St. Louis), Ill.

also
FERRISUL—An excellent coagulant
SANTOSITE—An efficient and economical reducing agent for removing dissolved oxygen

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Water Control Equipment

You will be interested in the complete line offered by MUELLER. Write for catalogs of the equipment in which you are interested.

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Factories: Decatur, Ill.; Chattanooga, Tenn.; Los Angeles, Calif.; Sarnia, Ont.

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END SCORING

Save shafts, save labor with Mabb's Type Chicago Rawhide braided (Hydraulic) packing that never hardens—retains its natural oil, never heats—is self lubricating and contains no grit like hemp, flax, etc.; is self-flushing. Good to the last strand—just add more. None to pull out or throw away, hence more economical than the cheapest substitute packing material.

Chicago Rawhide Hydraulic Packing (MABB'S TYPE)

Chicago Rawhide Mfg. Co.
1283 Elston Avenue
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JOINTS STAY TIGHT

HEAVY VIBRATION—from railroad and highway traffic—doesn't bother joints made with MINERALEAD ● At Burlingame, California, MINERALEAD-jointed pipes have for years been covered twice a day by the tides of San Francisco Bay ● MINERALEAD joints stay under all conditions ● MINERALEAD comes in ingot form—clean—easy to work—impervious to damp ● For further information write

The ATLAS MINERAL PRODUCTS CO. *of Pennsylvania*
MERTZTOWN PENNSYLVANIA

MINERALEAD

FOR JOINTING BELL AND SPIGOT WATER MAINS

pH AND CHLORINE CONTROL

ONLY GLASS STANDARDS *are always* ACCURATE

Noted authorities and all leading firms of the water supply field are using the Hellige non-fading, and, therefore, permanently reliable, glass standards and handy Hellige Comparators as they offer exclusive features and unequalled advantages. More than 500,000 standards now in use. Approved and highly recommended. One apparatus for chlorine, pH control, and many other popular tests.

Write today for detailed information.

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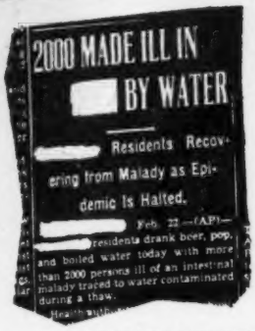
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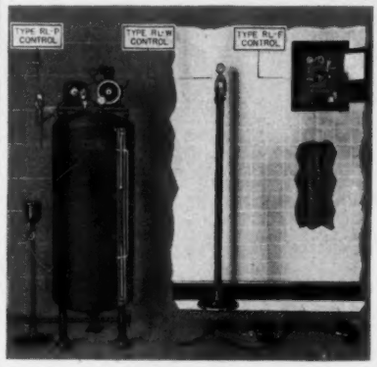

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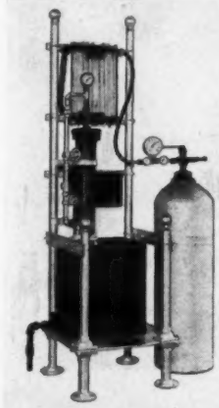

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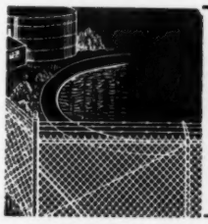

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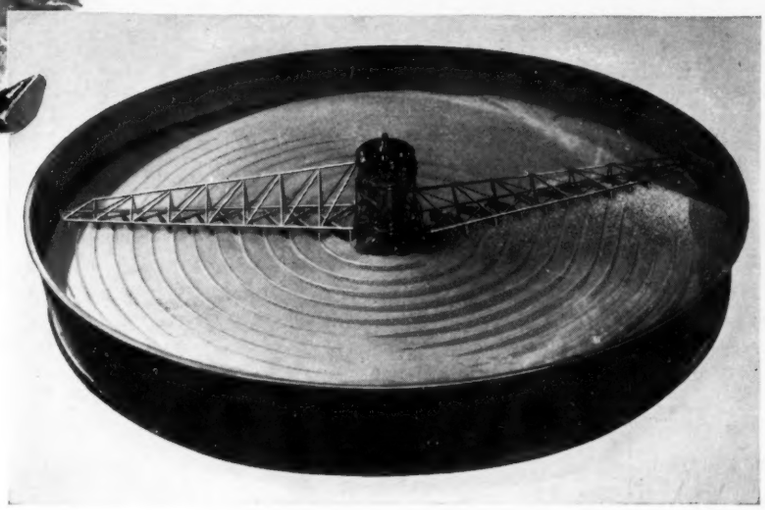

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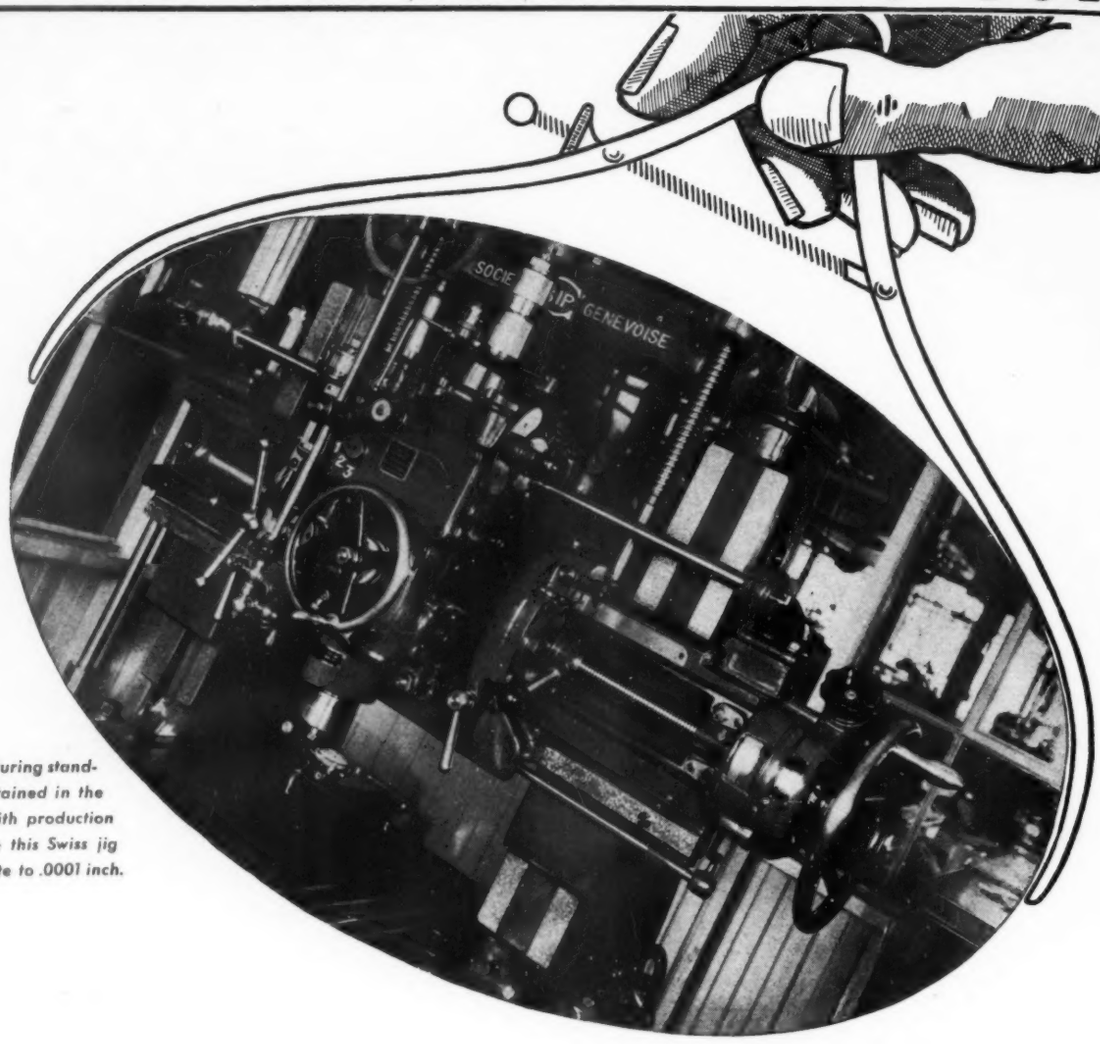

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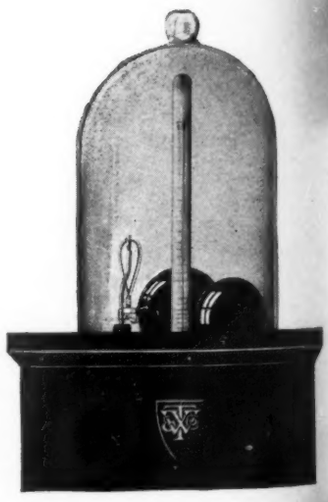

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